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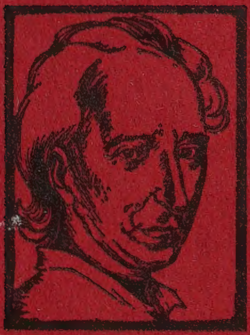

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NATIONAL SOCIETY FOR CLEAN AIR

Proceedings of the 28th Annual Conference Brighton

4th to 6th October, 1961

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SUMMARY OF EVENTS

The Conference was held in the Dome, Brighton, on October 4th, 5th and 6th, 1961, and was attended by 960 members and delegates. At the opening session on the Wednesday morning, with the new President of the Society, the Rt. Hon. Lord Cohen of Birkenhead in the Chair, the Conference was given a civic welcome by the Mayor of Brighton, Councillor G. B. Baldwin, J.P. Then followed an address by the Parliamentary Secretary of the Ministry of Power, Mr. John C. George, C.B.E., M.P., who formally opened the Conference and the adjoining Clean Air Exhibition. Finally, the Presidential Address was read by Lord Cohen.

On the Wednesday afternoon, Mr. Stanley E. Cohen, C.C., Hon. Treasurer, presiding, there were presented reports on the National Survey of Air Pollution, by authors from the Warren Spring Laboratory, the Society's proposals for a Bill for the certification of furnace operators—introduced by Mr. Sidney N. Duguid—and a Statement on behalf of the Executive Council on the problem of smoke from diesel vehicles. Each of these reports was discussed.

The Thursday morning session was on the industrial operation of the Clean Air Act. Mr. John Innes was in the Chair, and four papers, by Messrs. J. W. Batey, W. J. Dickie, C. M. Opie and A. F. Webber, were presented and discussed. Industrial problems were again discussed in the afternoon, in a " Questions and Answers " session, with Dr. J. L. Burn in the Chair, and a panel consisting of three of the morning speakers with Dr. A. Parker and Mr. H. A. Haines.

At the end of this session came the " Transatlantic Link " programme, in which a team on the platform in Brighton held a 30 minute discussion with a team of representatives of the Air Pollution Control Association of America, speaking from the Mellon Institute, Pittsburgh. The names of those participating are given in the record that follows on a later page. The U.S. side of the programme was filmed for television in Pittsburgh.

Only one paper was presented on Friday morning: on Whole House Heating Systems, by W. F. B. Shaw. The chairman was Mr. James Goodfellow. Domestic smoke was also the subject of the closing session in the afternoon, when there was a paper on smoke control areas by G. W. Herrick and one on the solid smokeless fuels position, presented for the Solid Smokeless Fuels Federation by Mr. David E. Baird. Mr. John Innes presided.

Finally came the moving, by Mr. Rodgers, Chairman of the North-West Division of the Society, of a general vote of thanks to all concerned with making the Conference so successful. Reference was made to the Mayor of Brighton, the officers of the Corporation, the Minister, the President, the Sessional Chairmen, the Authors, the Air Pollution Control Association of America, the Pfizer Group of Companies for sponsoring the Transatlantic programme, the Stewards, the Exhibitors and all concerned with the Exhibition, and the Society's staff.

The Clean Air Exhibition, held in the adjoining Corn Exchange and in a large tent on the lawn, was once more a notable success, both in the considerable interest and attention it created, and for the excellence of the many stands.

Social events during the Conference were the popular informal " get together " on the Tuesday evening, and delightful receptions by the Mayor and Mayoress on the Wednesday and Thursday evenings in the Royal Pavilion. There were also film shows in the Dome on these evenings with films of clean air interest.

ADDRESS

by

John C. George, C.B.E., M.P.

Parliamentary Secretary, Ministry of Power

IT is a great privilege for me to be present today to open the Conference and the Clean Air Exhibition. I should like to start with a statement of the problem—not mine, and not new!

> " It is this horrid Smoake which obscures our Churches, and makes our Palaces look old, which fouls our Clothes, and corrupts the Waters, so as the Very Rain, and refreshing Dews which fall in the several Seasons, precipitate this impure vapour, which, with its black and tenacious quality, spots and contaminates whatever is exposed to it."

This is not a quotation from an unknown play of Shakespeare, or one of Winston Churchill's wartime speeches. This is, in fact, the measured language of a Command Paper entitled " Fumifugium." It is true that the Command was given 300 years ago by his Sacred Majesty King Charles II, and that the author was that John Evelyn, the Father of Clean Air, who was the spiritual predecessor of your distinguished Immediate Past President, Sir Hugh Beaver. I congratulate the National Society for Clean Air on their initiative in again re-publishing this classic work, on the tercentenary of its first appearance.

John Evelyn was, of course, far ahead of his time in seeing the problem so clearly; since then, the problem has increased both in scope and intensity, tormenting wide areas of the country.

The " Black areas " are no credit to our sense of social well-being, nor indeed to our intelligence. I believe, that partly due to the helpful publicity that we have had on clean air—for much of which the Society has been responsible—the nation is alive to the fact that smoke is a menace to health and happiness, and can no longer be tolerated.

We have clean food and clean water; the country, I believe, is now determined to have clean air, and will not long tolerate opposition or dilatoriness in its achievement. That is why we are here now, and the Government welcomes your keen interest.

In the Clean Air Act, Parliament has given us the legislative tools for the job. Within the Government, the main responsibility for clean air lies with the Minister of Housing and Local Government, who devotes immense energy to this task. He maintains constant contact with the local authorities.

The Minister of Power also has important interests. First, he is concerned to see that adequate supplies of suitable smokeless fuels are available to ensure the speedy implementation of the Act. Secondly, he has a major interest in promoting fuel efficiency—although the pressure on our fuel resources has eased in recent years, it would be folly to waste fuel—as we did so wantonly for so long. Fortunately, fuel efficiency and smoke reduction go hand in hand.

It is specially gratifying for me to take part in today's proceedings, firstly, because I was a local authority delegate to the Society for some years, and secondly, since becoming Parliamentary Secretary, I have been closely involved in furthering the Government's clean air policy.

The main forum in England and Wales is the Clean Air Council and I serve on this as Vice-Chairman under Mr. Henry Brooke's chairmanship; I also, incidentally, keep an eye on the fuel aspects of the work of its Scottish counterpart.

Moreover, I have recently been asked to chair the Ministry of Power's National Advisory Committee on Solid Smokeless Fuels, which gives the Minister the authoritative advice of producers and distributors on all the various problems of smokeless fuel supply and demand. All this gives me a vested interest in the continued success of your efforts.

It is now five years since the Clean Air Act was passed, and the Act in its entirety has been in operation for more than three years. It is, therefore, a suitable time to look at the progress made so far, and to consider future prospects.

What Progress?

The basic question, of course, is—What progress can be recorded? Is clean air being achieved as fast as it should be?

The present programmes of the local authorities in England and Wales cover about six million premises in black areas, but at this moment only about 800 thousand of these premises have been covered by Smoke Control schemes; and it will be some time before all these are approved by the Minister and come into full operation.

The rate of progress has unfortunately been somewhat slower than that envisaged by the local authorities in their programmes published last year (Smoke Control, Cmd. 1113); they then expected that in 1959 and 1960 alone, they would be initiating schemes covering altogether 700,000 premises, but in fact only about half a million premises were covered. While clearly a useful start has been made we must hope for quicker progress in the future.

One disturbing feature is that, of the 294 English authorities whose areas are included in the provisional list of black areas, 73 have still not submitted programmes for making Smoke Control Orders.

I have heard two main reasons given for delays:

(1) doubts about the availability of smokeless fuels,

(2) the difficulties in overcoming the problem of miners' concessionary coal.

For reasons I shall develop in a moment, I do not think that fears about smokeless fuel supplies need now deter any black area from taking action against domestic smoke. Similarly, the indications are that the problem of buying back miners' concessionary coal is nearing a solution; and it, too, need no longer deter any local authority from acting.

The Government, therefore, hope that black area authorities in England who have not yet submitted a smoke control programme will now do so as a matter of urgency.

To help in accelerating progress generally, the Minister of Housing and Local Government has virtually abolished the so-called " provisional clearance " stage in the making of smoke control Orders.

I understand, that to reduce the burden of work on the staff of local authorities, and to speed progress with smoke control, the Minister is now seeking to streamline procedures further. He has in mind to ask local authorities for less elaborate financial returns; it may be that this will enable many local authorities, if they so wish, to abolish comprehensive door to door surveys in prospective smoke control areas. The local authority associations have been asked for their views on this proposal.

Meanwhile, we must rely on the local authorities and the weight of public opinion to advance the pace of clean air: and this is a field in which I feel that the Society for Clean Air—which has done so much already—can still make an important contribution.

Smokeless Fuel Supplies

As I indicated earlier, we in the Ministry of Power are principally concerned to see that adequate supplies of smokeless fuels are available when and where required for the clean air programme. The quantities involved at present are relatively very small—total domestic consumption of all forms of solid fuel is about 40 million tons, of which about one-sixth is smokeless. Clearly, the 350,000 or so premises in smokeless zones which are in full operation at present cannot consume much of that.

As the Clean Air programme advances, demand will undoubtedly increase; but to assess the level of this increased demand, and how it will affect consumption of the different smokeless fuels, involves peering into the murky future, a task made all the more difficult because the air there is far from clear or clean!

What proportion will continue on solid fuel? How many will choose gas, electricity or oil? We are watching closely, but it is yet too early to discern a pattern.

Last year, we had the benefit of the Report of the Peech Committee on Solid Smokeless Fuels, which had been set up to examine future supply prospects in Great Britain, and the adequacy of distribution arrangements. This valuable Report was reassuring generally, in that it confirmed that the overall supply would, so far as could be foreseen, be adequate for the next five years, after taking into account likely progress in smoke control; but it also spotlighted several matters requiring action, including a possible deficit of premium smokeless fuels in 1962, and a possible shortage of open fire smokeless fuels in the Northern Region, mainly affecting the North-east coast.

As the Minister of Power announced in Parliament on May 18th last, the Government welcomed the Committee's recommendations and considerable progress had been made in implementing most of them.

What, then, are the future prospects for the supply of smokeless fuels?

As has long been recognized, we must pin our hopes for some years mainly on good quality open fire coke which can be used satisfactorily in an improved grate: in most areas there is a prospect of adequate supplies of this coke and no local authority need hesitate to rely on supplies coming forward.

The gas industry is producing about one million tons under the trade name " Gloco," which conforms to the new British Standards Specifications for open fire coke, and a further three-quarter million tons of coke of similar quality, but not sold under this trade name.

Gloco

This represents a great improvement, but the Clean Air Campaign will not get the full benefit unless consumers are educated to expect neither too much nor too little from Gloco. To expect too much will lead to disappointment and criticism of the fuel: the consumer should not, for instance, try to use it on an *unimproved* grate, and where improved grates are installed, they must have the proper bar spacing.

To expect too little from it will lead to greater demands for other, better, but dearer, fuels, the extra cost of which may not be justified for the householder who has improved grates.

Although some progress has been made in educating the public in the use of Gloco and its capabilities, this inevitably takes time, and there is still a very great educational task ahead. Legally, smoke control areas can be created by Order, in fact, they can only be realities by long and careful preparatory work.

The supply of premium smokeless fuels has also been improved. Perhaps I should explain what I mean by premium fuels. They are the specially reactive solid smokeless fuels that can be burnt in any open grate and do not call for any special appliance. There is, incidentally, an interesting definition in the preface to the edition of Mr. Evelyn's tract which was published in 1772, more than a hundred years after it first appeared.

It speaks of " a method of charring sea-coal, so as to divert it of its smoke, and yet leave it serviceable for many purposes " and it adds prophetically " and premiums should be given to those that were successful in it" (page 40).

Between 1958 and 1960, output had increased by more than one-third from about 810,000 tons to about 1,130,000 tons; output now is at an annual rate of about 1¼ million tons.

Moreover, the gas industry has said that it has the capacity to produce greater quantities of premium fuels, and the private producers are expanding their capacity. Looking further ahead, the National Coal Board is making progress with the development of two new smokeless fuels, of which they expect to be producing one million tons a year in 1965, and further expansion thereafter is contemplated.

There should, therefore, be no cause for concern about the overall supply of premium smokeless fuels in the next few years. A high level of demand can be met if desired; but producers must be guided by the markets. Production will follow, and not precede demand.

This again emphasises the need for local authorities to have their programmes on paper. Producers must have some evidence on which to base their development.

During the past few months, the Government has been in touch with producers about the position in the Northern Region. The problem here is that the gas industry produces comparatively little open fire coke, partly because it purchases most of its gas from the coke ovens which produce hard coke suitable only for use in closed appliances.

As a result of our discussions, however, additional supplies of coke can now be made available in this region when needed, and there is no longer any fear that fuel shortages there will bring clean air to an early halt.

The recent decision of the Minister of Housing and Local Government to pay grant on closed stoves should, given the co-operation of local authorities, also help as the hard coke which these appliances prefer is in plentiful supply.

To sum up, the Government is doing what it can to advance the pace of clean air. The Ministry of Housing and Local Government have submitted proposals to the local authority associations for simplifying the procedure for the establishment of smoke control areas, and this should enable the local authorities to go ahead faster in the future than in the past.

We, on our side, are confident that the smokeless fuels will be there when needed. We are also confident that these fuels, properly used, give good value for money spent.

But all this is not enough. You have been crusading for many long years. The crusade must go on, and the need for clean air must be kept continually before the public, and—should I add—before the local authorities? This is where your Society and all those present can play a part of great importance. I know you will not relax your efforts, and I wish you every success and satisfaction.

PRESIDENTIAL ADDRESS

by

The Rt. Hon. Lord Cohen,

P.R.S.H., M.D., D.Sc., LL.D., F.R.C.P.

MY first words must be of warm gratitude for the enviable privilege and signal honour of being elected President of this Society. The honour is enhanced for me because my predecessor is Sir Hugh Beaver. His occupancy of the Presidential Chair is a measure of its prestige, for when the history of Government action in trying to stem the evil effects of atmospheric pollution is recorded, to no name will higher tribute be paid than his. It was the Report of the Committee on Air Pollution which he chaired, which alerted the country to the widespread evils which flow from atmospheric contaminants, and which removed the idea of " Clean Air " from the realm of eccentricity, fad and obsession, to become a National goal.

To elect a physician as your President is to recognize the grave consequences to health of atmospheric pollution. There are many definitions of health, and not one is wholly satisfying to anybody but him who drafts it. Yet for practical purposes, I commend that of the World Health Organization, namely, " a state of complete physical, mental and social wellbeing, and not merely the absence of disease or deformity."

This definition makes us aware of the complexity of the problem of atmospheric pollution. Physical wellbeing must take account of man's comfort. Thus arises a vicious circle. Man's search for comfort and pleasure has poisoned the air we breathe. At first the fumes from his log and peat fires which warmed him, and then from coal, which even in the 13th century were recognized as prejudicial to health. Soon industry was indicted. In 1627 Charles I asked the Royal College of Physicians of London to investigate a complaint about the alum works in Aldgate, its " loathsome " vapour annoying the inhabitants within the radius of a mile, and also it was alleged that it tainted the pasture and poisoned the fish in the Thames. The Royal College of Physicians' Committee, which on investigation found the complaint justified, included in its membership the famous William Harvey, discoverer of the circulation of the blood.

In 1661, was published John Evelyn's *Fumifugium*, and our Society is to be warmly congratulated on its tercentenary reprint of this classical text. In it Evelyn deplores with just and unrestrained indignation that the " Glorious and Antient City " of London " should wrap her stately head in Clowds of Smoake and Sulphur, so full of Stink and Darknesse."

With the 18th and 19th centuries came more furnaces, factories and steam-engines, and also an increasing density of urban populations exposed to the smoke polluted air. The 20th century saw in addition the fouling of air with the exhaust gases of automobiles, and then as man's scientific genius reached a crowning peak in unmasking Nature's secrets, we used the knowledge of the atom to blast into the sky the mushroom cloud of the atomic bomb, and so gave birth to a pollutant which could not only destroy man, but, if he survived its onslaught, could condemn his offspring.

It is in retrospect puzzling that only sporadic and half hearted efforts were made by Governments to deal with the effects of increasing air pollution. The long struggle of this Society for the recognition of the importance of Clean

Air reflects the difficulties which reform encounters, but it is heartening to record that when this Society held its first post-War Conference in Brighton in 1946 all previous attendance records were broken, even though that Conference was less than half the size of that now assembled.

It is true that certain episodes made a forceful impact on public opinion, but Governments paid little heed to these isolated incidents (though there were at least five in London in the last quarter of the 19th century with a striking number of deaths) and voluntary effort had no wide support.

Two episodes, one in the U.S.A., and the other in London, were to transform the public's attitude, and to spur Governments to action.

The first took place during the last week of October, 1948 in the city of Donora, some 30 miles south of Pittsburgh, and the seat of a large steel industry and zinc reduction plant. Fog developed on the morning of the 27th October, and with it an accumulation of atmospheric contaminants. Four days later rain cleared the air, but in those four days there were seventeen deaths as against the normal expectation in that period of two; 5,910 persons (42.7 per cent of the population) were affected by varying degrees of cough, irritation of the eyes, nose and throat, breathlessness and vomiting; in a quarter of the population the symptoms were severe. Over 60 per cent of the affected were 65 years of age or over. The importance of this episode lies in the fact that the United States Public Health Authorities were invited to assist in making an intensive epidemiological survey in which meteorologists, physicians, chemists, fuel engineers and others all cooperated. This was indeed the initiation of the extensive research programme in this field which is now being undertaken in the U.S.A. The second, and much more tragic episode, occurred in London between the 5th and 9th December, 1952. Its features are too well known to need repetition except to remind you that of its toll of 4,000 deaths, although all ages suffered, the main victims were the old, especially those suffering from chronic bronchitis and chronic heart disease. As in the Donora episode SO_2 seemed the chief offender. There was six times the average amount of SO_2 in the air, and it was estimated that 60 per cent of this was due to domestic fires.

It was this tragic event which led to the appointment of the Beaver Committee; it was the Report of that Committee which made our own Government aware of its responsibilities for Clean Air, and it led to the Clean Air Act of 1956.

It is not, however, these dramatic acute incidents which are the main concern of the physician. The questions which he must attempt to answer are " what is the effect on health of prolonged exposure to small amounts of air pollutants? " " What part do they play in the causation of chronic disease, or in rendering a person more liable to acute disease? " Here let me interpolate a warning against a too simple conception of cause in disease. We know that the tubercle bacillus is a *necessary* cause of pulmonary tuberculosis. Yet it is not the *only* cause. Crowding, malnutrition, lack of fresh air—all play a part in increasing our susceptibility to infection with the tubercle bacillus. These are therefore, *non-specific predisposing or contributory causes.* And so, in assessing the effects of air pollution we must bear in mind the diseases to which it renders us less resistant, and not simply the diseases due to a specific pollutant, e.g. the fumes of arsenic.

In considering this problem we must appraise carefully the available facts and not be oppressed by theory. For example, it is a fact that a heavy cigarette smoker is several times more likely to develop cancer of the bronchus than the non-smoker, and the prudent man will heed this fact and not reject it if a theory which seeks to explain this relationship is proved invalid. Though we search strenuously for the specific offending pollutants in the air we do not need to know them to show that polluted air of undefined composition is injurious. A century ago John Snow knew that polluted drinking water could cause cholera, though many years were to pass before the causative organism of this disease was discovered.

Physicians have long been concerned with the effects of air on disease. One of the earliest Greek medical texts, written 2,300 years ago, is Hippocrates' *Airs, Waters and Places.* And the name " malaria " or " bad air ", introduced by Francesco Torti in the early 18th century, concealed what we were to learn in this century, that the bad air arose from swamps in which flourished the female mosquito larvae which in adult form carried the malarial parasite from man to man. The doctrine of *Miasmas*—disease due to the noxious exhalations or vapours arising from putrefaction of organic material—was the explanation of the infectious fevers in the 18th century; and alterations in barometric pressure played, according to Mead and his contemporaries in the 18th century, an important role in the genesis of both physical and mental disease.

With the development of scientific medicine and the discovery that man breathes oxygen, nitrogen, carbon dioxide and many inert gases in small amounts, came the recognition of the inevitable pollutants.

Of these pollutants some occur naturally and others are man-made. The natural pollutants include pollen (which is responsible for much discomfort and disease in the form of hay fever and asthma), decay of organic material, volcanic dusts and even dusts from outside the earth's atmosphere.

But it is the man-made pollutants which in today's context concern the physician. Their effects on man may be toxic or irritant, or they may be responsible for allergies. They can, of course, affect man indirectly by their toxic effects on animals or plants which provide his food; they can increase his liability to accidents because polluted air impairs visibility; they can interfere with his aesthetic pleasure when objects of architectural beauty are discoloured or blighted, and even the economic consequence of damage by pollutants may play a part in the development in man of anxiety states.

I have already exemplified the dramatic effect of sudden exposure of a community to an excessive degree of atmospheric pollution. The effect of more prolonged exposure to smaller amounts of pollutants has been less intensively studied until recent years except in regard to, firstly, the creation of a highly individual and personal pollution with cigarette smoke with its resultant chronic bronchitis, bronchial cancer and chronic heart disease, (though the cigarette smoker can render an enclosed space, such as a railway carriage, public room, theatre or concert hall, intolerable to the chronic bronchitic or asthmatic); and secondly, the pollution associated with industrial processes which increase the atmospheric content of hydrochloric acid, arsenic, fluorine, beryllium, lead and dusts responsible for pneumonoconiosis, *e.g.* silicosis, asbestosis, byssinosis, bagassosis, etc.

These occupational diseases have attracted research into preventive measures, and many have been devised and some made statutory. But the problems of air pollution in industry and in the community are not strictly comparable. In industries a specific pollution can be indicted; in community pollution there are many non-specific pollutants such as dust, smoke, SO_2 NO_2, ozone, carbon monoxide, hydrocarbons, etc., which are derived from coal fires, industrial furnaces, automobile exhausts, and the like. Again the worker is exposed intermittently to the pollutants, say for eight hours a day, and is usually a healthy person, whereas community exposure is for twenty-four hours a day with no remission, and it affects all ages.

It is, however, important to remember that industrial specific pollutants may escape and affect those living in the neighbourhood of a plant, but not connected with it; for example, beryllium which produces a clearly recognized lung condition (chronic pulmonary granulomatosis), chronic carbon monoxide poisoning near gasworks, and very rarely cases of chronic manganese and chronic fluorine poisoning have been described in which the pollutant appears to have originated in a neighbouring factory. Many industries add to the community air load of allergens. These include baking, cotton milling, processing fur, jute, feathers and hair; manufacture of felt hats, carpets, leather, soap, furniture, tobacco, and even castor oil, whose extraction from the castor bean frees a powdery material which is highly allergic. These form admittedly quite a small part of the problem of allergy, except for those actually exposed in industry. Most of the atmospheric allergens are naturally occurring, *e.g.* pollens, and are thus less controllable.

Our knowledge of the relation of chronic disease to atmospheric pollution in Great Britain is largely derived from epidemiological and statistical evidence, for the subject as yet lends itself with difficulty to experimental study. Yet there are no richer opportunities for such epidemiological studies than in Great Britain where over one million tons of smoke are still emitted yearly from domestic fires, half a million tons from industry, and 100,000 tons from our railways. Domestic chimneys are responsible for 100,000 tons of grit and dust out of a total of 900,000 tons belched yearly into the atmosphere; and of the five and a half million tons of SO_2 emitted, domestic fires contribute nearly one million tons. It is not surprising that the inhalation of this filth and poison should affect the respiratory tract, as is seen in chronic bronchitis with its cough, expectoration, breathlessness and heart strain; the high incidence of this disease in this country has earned it the eponym of "the English disease". The death rate from chronic bronchitis in England and Wales in males is about fifty times higher than in Denmark, and about twenty times higher than in Norway and Sweden. Not only are the deaths from chronic bronchitis rising (in 1954, there were 25,780, and in 1959, 29,051) but this disease is responsible for 10 per cent of all industrial absenteeism amounting to over twenty-five million working days. It has been long recognized that chronic bronchitis occurs more frequently in towns than in country areas, and that it is closely related to the density of population. A convincing demonstration of the relation between pollution and bronchitis was provided by the study in this country by Fairbairn and Reid in 1958, who investigated sickness amongst postmen. In 37 towns they found wide variations in the rates of absence from work due to this disease, but these were strikingly correlated with the indices of air pollution based on the frequency of fog in these towns. No part was played by social, economic or other climatic factors. But not only was the frequency of chronic bronchitis related to pollution, the character of the disease varied also. Minor infections in younger bronchitics appear to be independent of the degree of pollution. It is the older chronic bronchitic postman in polluted areas in whom these minor infections lead to more frequent absence from work, and seem more often to lead on to such complications as pleurisy, pneumonia, and circulatory failure, which hasten death. When this effect on the older populace is considered, we should recall that our population is an ageing one, and in the years to come, even if pollution does not increase, the increasing age of our population will result in more widespread disease and disability.

Many other investigators, both before and since, have confirmed this study of the association between pollution and chronic bronchitis. A recent paper by A. E. Martin (1961) is worth noting. He quoted P. J. Lawther who found that the subjective feelings of the patient were the most sensitive indices of morbidity. He asked patients to keep diaries recording their general condition and whether they were "better than",

" the same as ", or " worse than " the day before. Using this method he found the degree of illness was closely related to atmospheric pollution, as shown by daily measurements of smoke and SO_2. An important fact showing that the patients were not unduly influenced by the appearance of the weather was that periods of low visibility did not always correspond with a deterioration in the condition of the group.

Another recent important study by Boyd (1960) analysed data from the City of London for seven consecutive winters, concerning the weekly total deaths from various respiratory and cardiac conditions, and weekly indices of smoke pollution, atmospheric SO_2, mean daily minimum temperatures, vapour pressure and visibility. The temperature, humidity and visibility indices were found to have no significant effect on deaths from lung or heart disease, but there was a close relation with the amount of pollution due to smoke and SO_2.

Another worthwhile investigation is that of Dr. Percy Stocks (1960) whose studies showed that the incidence of lung cancer was strongly correlated with smoke density in the North of England, and a similar though weaker correlation was found within Greater London. Bronchitis and pneumonia in men, and bronchitis in women showed similar strong correlations with smoke pollution. An interesting finding was that cancer of the stomach and intestines are related significantly with smoke in the thirty County Boroughs which were investigated, whilst cancer of the breast in women shows no such relationship. Analysis of the smoke showed that for lung cancer and bronchitis, 3 : 4 benzopyrene was the predominantly guilty compound, though it had little effect on pneumonia. Stocks' analysis of trace elements showed that for lung cancer beryllium and molybdenum were most closely correlated, though for bronchitis the correlation was stronger for molybdenum. Here again, female breast cancer showed no relationship with trace elements.

It must be conceded that correlation tests indicate simply a mathematical association and not necessarily cause and effect. Conclusions from such studies must, therefore, be drawn with care and restraint, but when a whole corpus of results from many varied sources admit of only one interpretation, it is sheer folly to neglect their implications.

We must, nevertheless, seek additional evidence. All recent studies have been retrospective, *i.e.* patients suffering from disease have been questioned about their past history. Such recollections are fallible and occasionally misleading; also we cannot with certainty exclude from past history the effects due to pollution, associated weather conditions such as frost or snow, and concomitant epidemics, for example, of influenza. More helpful and less vulnerable evidence will be given by forward looking or prospective studies in which a group of individuals whose health has been defined initially, and whose respiratory symptoms, such as cough, sputum production, breathlessness, can be studied at regular intervals in the future. The difficulties of such an investigation are formidable, but they have to be faced, and the Medical Research Council has begun such a study on Transport and Post Office workers in London. Quick results cannot, however, be expected. All the evidence suggests, that long exposure to small amounts of pollution is needed before the effects are seen and felt.

Unfortunately, animal experiment in this field is of little value, and experiments on human beings are unthinkable except for one. We can watch with care the effects of the Clean Air Act, of removing smoke and offending pollutants from the atmosphere of our cities. If what we believe is valid, then we can expect in smokeless zones a reduction in the incidence of chronic bronchitis, bronchial cancer, and other diseases in which air pollution is a contributory cause, provided, and it is an important reservation, that two other highly relevant factors—namely, cigarette smoking and automobile exhaust gases, do not gain so much in strength that they offset the benefit of air cleansed from other pollutants.

I do not propose to add to what I have said in many other speeches on the relationship of cigarette smoking and cancer. But I must say a few words on the pollution by automobile exhausts which is an increasing and urgent problem of our major cities. We have not yet experienced the eye-irritating pall which blots out the sun, as in Los Angeles, where three million cars burn five million gallons of petrol daily, and which has inspired so much engineering research on methods of control. In this country, however, the exhaust from automobiles is now aggravated by that from diesel-oil propelled vehicles. It is true that there is, as yet, no secure evidence that smoke and fumes from this source are detrimental to health, but there are adequate reasons for abating the nuisance; it creates dirt and gives rise in other road users to danger, annoyance and frustration. Coasting behind a vehicle belching dark and irritating smoke from its exhaust may contribute not a little to the impatience and resulting faulty judgment which lead to taking unwarranted chances in overtaking, and may thus cause many a road accident.

We are not yet confronted seriously by the problems of radiation hazards, though some areas have been exposed to radioactive pollution from effluents from nuclear reactors, from nuclear chemical processing plants, from radiochemical laboratories, and hospital incinerators, and from the as yet apparently harmless " fall out " from nuclear weapon testing. But recent history suggests that the chronic effects of radiation, such as those giving leukaemia and cancer, infertility, premature ageing, and genetically determined deformities, might become a major problem even if we are spared a nuclear holocaust.

I fear that I have traversed superficially a wide field, and I have left untouched many of the varied problems of pollution in fields other than health. But are we not justified for health reasons alone in proceeding with the implementation of the Clean Air Act, with much greater speed? Why is there such opposition and delaying tactics to this splendidly worthwhile social enactment, when it could yield such dividends and lessen illness, death and human misery, diminish medical costs and absenteeism, increase productivity and significantly decrease our expenditure on artificial illumination, on the repair and renovation of buildings, on damage to crops and to animal welfare, and improve our fuel resources?

A few figures will clearly show the economic advantages of control in these fields. In France, for example, a study made in 1957, revealed that additional expenditure due to pollution on cleaning and provision of clothes, on repairing houses, on building maintenance, in reduction of earnings, and cost of medical services totalled £160 million. In this country one ton of smoke causes over £20 worth of damage, that is, each ton of coal we burn dissipates 7s. 6d. needlessly. Living in the country as opposed to the city saves over 50 per cent in laundering, and increases the life of clothes. Increasing pollution in the past few years has decreased the life of zinc work from 30 years to, in the worst areas, 4-5 years.

Clearly we cannot expect to eliminate all sources of pollution. Manufacturing processes must continue, and cars must be driven, but we can make a much weightier contribution than at present by using to the full current knowledge of pollution control, and by carefully planning and siting all factories and houses; also we must pursue research more intensively and bring to the solution of pollution problems all relevant disciplines. We need, for example, to know more about the best design of fire equipment in factories, about measures for preventing combustion of the culpable fuels, etc. In the automobile field, for example, much experimental progress has been made with catalytic combustion devices in exhaust pipes, so that unburnt hydrocarbons can be reduced by 92 per cent by conversion to carbon dioxide, and by similar conversion we can eliminate 75 per cent of the excess of carbon monoxide. Again, carburettor adjustment and possible injection of water could reduce by 90 per cent the emission of nitrogen oxides (Drinker 1961). Novel and less harmful forms of motive power which are now available experimentally may play an important part in future control.

We cannot brook delay. Our present knowledge if applied could do much to cleanse the air we breathe.

One of the most pressing problems of this Society is to persuade and educate authorities to face their responsibility and to help them with their problems. We should remind them, to quote from the Beaver Report, that proposals for abating air pollution " if carried out will secure happier and more healthy living conditions for millions of people and that on all counts the cost and cure will be far less than the national loss in allowing the evil to continue ". And even if there is considerable expenditure needed did not John Webster have the heart of the matter when he wrote three and a half centuries ago that " Gold that buys health can never be ill-spent ".

We must press when needs be for additional legislation whatever the opposition or obstruction, however dire the prophecies of commercial ruin, however clamant the voices raised in protest against a so-called loss of individual liberty, for these too often give no thought to the welfare of others.

The tasks of this Society are indeed onerous, but so is the burden shared by all who seek to promote social and health reform. But we must be resolute, and in our resolution recall Disraeli's dictum that, " The health of the people is really the foundation upon which their happiness and all their power as a state depend ". Then we can with confidence sustain our burden and our cause.

It is, indeed, because I admire so warmly the past achievements of this Society and have unbounded faith in its capacity to further the welfare of the citizens of this land, that I feel so honoured by occupying its Presidential Chair.

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THE NATIONAL SURVEY OF AIR POLLUTION

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MEASUREMENTS of air pollution have been made since 1914 by Local Authorities and other interested bodies, in co-operation with the Department of Scientific and Industrial Research, and up to the time that the Beaver Report was issued, in 1954, they provided an adequate, if rough and ready picture of air pollution in towns. Since that time these measurements have been multiplying rapidly as the nation has become increasingly aware of the benefits of clean air. The initiative of the Local Authorities in making measurements was such that by 1958 there were in operation 1,200 lead dioxide instruments, 1,100 deposit gauges for measuring grit- and dust-fall, and 260 sets of apparatus for measuring the concentrations of smoke and sulphur dioxide. The compilation and publication of these observations were undertaken by the Department.

After the issue of the Beaver Report in 1954, it was realized, both within the Department and outside, that the whole scheme of measurements ought to be examined in relation to present-day national requirements, and, if necessary, re-organized in such a way as to get the maximum value from the most economical effort. Therefore in 1959, Warren Spring Laboratory appointed a small technical working party to examine the whole position and to make recommendations. The composition of this working party was as follows:

- Mr. S. H. Clarke (Chairman), *Director, Warren Spring Laboratory.*
- Mr. N. Bastable, *Chairman of the Standing Conference of Co-operating Bodies, and Chief Public Health Inspector, Barking.*
- Dr. S. G. Burgess, *Chief Scientific Adviser, London County Council.*
- Dr. S. R. Craxford, *Warren Spring Laboratory.*
- Dr. L. E. Hockin, *Alkali Inspectorate, Ministry of Housing and Local Government.*
- Mr. A. R. Atherton (replaced by Mr. G. Hopkinson), *D.S.I.R., Headquarters Office.*
- Dr. P. J. Lawther, *Director, Air Pollution Research Unit of the Medical Research Council.*
- Mr. P. J. Meade, *Meteorological Office, Air Ministry.*
- Mr. P. J. Harrop (replaced by Mr. K. F. Munn), *Ministry of Housing and Local Government.*
- Mr. D. W. Slimming, *Warren Spring Laboratory.*
- Mrs. M.-L. P. M. Weatherley (Secretary), *Warren Spring Laboratory.*
- Mr. R. Williams (deceased), *Chief Public Health Inspector, Coventry.*

The Working Party reported in November 1960 and after long and detailed discussion its report was accepted by the Standing Conference of Co-operating Bodies. The substance of this paper is largely based on this report, summarizing its main recommendations and the progress that has been made towards their implementation.

Reasons For A National Survey

It was agreed that it was desirable to obtain as accurate a record as possible of the amount of pollution in the air where people live and work, in order to judge the success of any remedial measures that may have been taken in any particular locality, and also to assist Local Authorities in considering plans for future industrial development in relation to present levels of air pollution. These points are the concern of both local and central government and form a suitable subject for co-operative investigation. In addition, a quantitative picture of the pattern of air pollution throughout the country was required for medical investigations into the connection between air pollution and disease.

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It was clear, therefore, that those measurements which help to characterize pollution in the towns in which they are made should be retained, and extended where necessary, to build up a statistically-significant pattern of pollution to serve both as a yardstick against which pollution in individual towns can be judged, and as a means of estimating pollution throughout the country. On the other hand, those measurements which have only a more restricted significance should be examined very closely by the Local Authority or other organization responsible for making them, and only retained if there is no doubt as to their local value.

Pollutants To Be Measured

Smoke and its control are of prime importance under the Clean Air Act and measurements of smoke concentrations should, therefore, form the basis of any national survey. Smoke particles can reach and be retained in the lungs, so that a knowledge of their concentration is significant also for medical purposes. The daily smoke filter is considered basically suitable for such measurements and if care is taken to install the instruments where they are not affected by local sources of pollution (for example, by drifting smoke from chimneys or by road traffic) they give readings characteristic of the district of a town in which they are situated, so long as this is reasonably homogeneous. Every smoke measurement that has been made provides a valuable contribution to our knowledge of the distribution of smoke in towns throughout the United Kingdom, and so should be continued, but to build up an adequate national picture it was clear that both the number of towns making measurements and the number of sites in some towns would have to be increased.

Sulphur dioxide is another pollutant of national significance because of its possible effects on health and property. The hydrogen peroxide method is basically suitable for measuring concentrations of sulphur dioxide and all observations that have been made with it are valuable for a national survey and should be continued; but again, as for smoke, the number of towns making measurements, and in some instances the number of sites, would have to be augmented to build up an adequate national picture.

The lead dioxide instrument, which is in common use, does not measure concentrations of sulphur dioxide and as the correlation between its readings and the concentration of sulphur dioxide appears to be affected by variables outside the control of the observer, it is not suitable for use in a national survey. Local Authorities and other bodies maintaining these instruments have been informed of their limitations and have been urged to examine the value they themselves are obtaining from their results; if this is not commensurate with the expense of maintaining the observations they would be well advised tc discontinue them.

Grit and dust are mainly of industrial origin and fall fairly close to their source. The resultant pollution is therefore extremely localized, so that a broader national picture of grit- and dust-fall would be all but meaningless even if it could be obtained. And since grit and dust are too coarse to reach the human lung (at least those fractions that predominate by weight in the material collected by the deposit gauge), the figures obtained are not likely to be required for medical purposes. It is clear that the correct use of the deposit gauge is for monitoring local emissions. Measurements made over many years have shown that there is no clear and useful connexion between the data obtained from the deposit gauge and pollution by smoke and sulphur dioxide. Taking all these points into consideration, it was decided that the deposit gauge should not be included in the national survey. Local Authorities and other bodies operating deposit gauges have been informed of these facts and have been urged to satisfy themselves that their results have a local value to them commensurate with the expense, and that if this is not so they should consider discontinuing the observations. It has also been explained to them that except in special circumstances the only figure obtained from the analysis that has any clear significance is that for insoluble matter, which is, in fact, largely the grit and dust. These special circumstances concern measurements made in cement-dust areas, near iron works, etc., when analyses for calcium or iron can be very illuminating.

These decisions on instruments are entirely in accord with, and partly based on, the work of an international OEEC Working Party on Instruments for the Measurement of Air Pollution, of which one of the authors (S.R.C.) is Chairman.

After the existing measurements had been considered in the light of the above conclusions, it remained to decide in detail what measurements of smoke and sulphur dioxide would be necessary in order to build up a statistically-valid picture of air pollution throughout the United Kingdom.

Planning the National Survey

The Rothamsted Experimental Station was consulted as they were experienced in organizing this type of survey. They agreed that it would be reasonable to divide all the towns in this country into categories according to their suspected air pollution characteristics and then from each category to make a random selection of representative towns in which measurements should be made.

(*a*) *Categories*

Of the many possible factors that might be used as a basis for dividing towns into categories, the following seemed the most valid:

1. Domestic coal consumption per unit area.
2. Industrial coal consumption per unit area. (Chosen as an index of degree of industrialization).
3. Natural ventilation. (To take into account the tendency for pollution to be trapped or blown away).

Each of these three factors was then sub-divided into high, medium or low levels and the following scheme of classification adopted:

Domestic coal consumption per unit area:	low	D_1
	medium	D_2
	high	D_3
Industrial coal consumption per unit area:	low	I_1
	medium	I_2
	high	I_3
Natural ventilation:	good	A_1
	medium	A_2
	poor	A_3

As any one of these items can be combined with any other, this scheme results in a total of 27 categories.

It was decided at this stage to treat England and Wales as one unit and Scotland as another, taking into consideration both the sets of conditions governing air pollution in the two areas and the fact that a planned survey has been operating in Scotland for the past few years. As soon as the organization of the survey in England and Wales has reached a sufficiently advanced stage, the existing sites in Scotland will be codified and certain additional measurements will be asked for so that the data from the Scottish survey may be directly comparable with that coming in from England and Wales.

A representative sample of towns from England and Wales was then chosen as follows:

All the towns in the country, (*i.e.*, all administrative areas other than Rural Districts), were divided into the 27 categories, with the exception of a number of small towns for which information on industrial coal consumption could not be obtained. These were put into a separate category. Some of the categories contained no entries; for example, no towns with a high degree of industrialization could be expected to have a low domestic coal consumption per unit area. Four categories had so few entries that they were combined in pairs to make two. These were D_2, I_3, A_1, and D_3, I_3, A_1, and D_2, I_3, A_2, and D_3, I_3, A_2. The final result was a total of 18 categories.

Within each category the towns were then divided by population into five groups as:

A. Above 250,000
B. 100,000 to 250,000
C. 50,000 to 100,000
D. 20,000 to 50,000
E. 5,000 to 20,000

For the present stage of the survey, towns of less than 5,000 population have been omitted.

Within each of these groups, the towns were arranged systematically according to their geographical position, as expressed by the Ministry of Power's Fuel Regions. Selection of a representative sample from each category was then made by taking all towns in group A, every second town in group B, every third town in group C, and, by random selection (using a Table of Random Numbers) one-tenth of the towns in group D and one-twenty-fifth of those in group E. This ensured that for each category the representative sample was geographically distributed over the country in a way consistent with the method of selection adopted.

The total representative sample for all the categories contained 120 towns covering a wide range of degree of pollution and giving a proportionally higher degree of representation to the towns of higher population. Measurements of smoke and sulphur dioxide were already being made in about half of those selected towns.

Because of its size it was decided that Metropolitan London would have five times as many instruments as other towns, in sites selected at random from the whole area; this was considered more logical than selecting five metropolitan boroughs at random because of the variations in area and shape amongst the boroughs.

(*b*) *Siting of Instruments*

The siting of instruments in the selected towns is perhaps the next important individual item to be attended to in the survey as it is essential to choose sites that will give readings characteristic of the surrounding district and comparable with those made in other towns. It was decided that for each town an instrument should be placed in each of the following five types of district:

1. Residential district with high population density, *e.g.*, old-fashioned terraced housing,
2. Residential district with low population density, *e.g.*, a modern council housing estate,
3. Industrial district,
4. Commercial centre of a town,
5. Smoke-control area.

In some towns, not all these types of district are to be found, so that fewer gauges than five are required.

The selected towns have now been approached and the vast majority have agreed to co-operate. The Warren Spring Laboratory and the authors would like to take this opportunity of recording their thanks to those Local Authorities who have so kindly taken on this extra work and expense for the public good. It may be necessary to ask certain extra towns to make measurements for special aspects of the survey.

The data obtained from measurements in the statistically selected representative towns will be used to provide a yardstick for each category of town, and for the country as a whole, against which the data from individual towns will be examined. Thus all the daily smoke and sulphur dioxide measurements being made in the country will, in fact, form part of the national survey.

Table I contains a list of the towns in the national survey, both representative sample towns and other towns making measurements.

As an aid to the interpretation of the data from this national survey it was decided that it would be of the utmost value if arrangements could be made for the intensive survey of one or two towns on the lines of the classic Leicester survey, and by a fortunate set of circumstances it has been found possible to implement this decision. Arrangements have been made to collaborate with the Department of Geography in the University of Reading for a survey of that town, and the work is now in progress. The Medical Research Council's survey of Sheffield has now been taken over by the Warren Spring Laboratory and will be extended to meet the new requirements. Here, again, work is actively in progress. There is also the possibility that a detailed survey of Edinburgh may be arranged.

Measurements Outside the National Survey

Finally, a word should be said about the measurements Local Authorities and other bodies are making for their own local purposes, outside the national survey. Warren Spring Laboratory will continue to help with these measurements by advice on sites, and by publication and discussion of summaries of the results. Going further, it has set up a Working Party to advise in detail on the field of usefulness of the lead dioxide instrument and, at the request of the Standing Conference, is codifying all the deposit gauge sites so that it will now be possible to make valid comparisons of the results from one district with those from another.

Since this national survey was started, the terms of reference of the OEEC Working Party on Instruments for the Measurement of Air Pollution have been extended to include survey techniques, and it is confidently expected that the work described in this paper will enable the United Kingdom to play a leading part in this wider European attack on the assessment of our pollution problems.

In conclusion, the authors would like to thank Dr. D. Boyd and Mr. B. Church, of Rothamsted Experimental Station, for their help and advice on the design of the survey.

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Table 1

NATIONAL SURVEY OF SMOKE AND SULPHUR DIOXIDE

Representative Sample

(Asterisks indicate towns in which daily measurements have been made for some time)

County Boroughs	*Classification*
Birkenhead	$D_3I_1A_1$
*Bradford	—
Bristol	$D_3I_2A_3$
Bury	$D_2I_2A_2$
*Cardiff	$D_3I_2A_1$
Chester	—
*Coventry	$D_2I_2A_1$
*Derby	$D_3I_2A_2$
East Ham	$D_3I_3A_3$
Eastbourne	—
*Halifax	$D_2I_1A_3$
*Huddersfield	—
Ipswich	—
*Kingston-upon-Hull	$D_3I_1A_1$
*Leeds	$D_3I_2A_3$
*Leicester	—
Lincoln	—
*Liverpool	$D_3I_2A_1$
*Manchester	$D_3I_2A_2$
Middlesbrough	$D_3I_3A_1$
*Newcastle-upon-Tyne	$D_3I_2A_2$
*Norwich	$D_2I_1A_1$
*Nottingham	—
*Oldham	—
*Oxford	$D_2I_1A_2$
Plymouth	$D_2I_1A_2$
*Portsmouth	$D_3I_2A_1$
*St. Helens	$D_3I_2A_1$
*Sheffield	$D_3I_2A_3$
*Southampton	$D_3I_2A_1$
Southend-on-Sea	$D_2I_1A_1$
*Stoke-on-Trent	—
Sunderland	$D_3I_2A_2$
*Walsall	$D_2I_2A_1$
*Warrington	$D_3I_2A_1$
*West Bromwich	$D_3I_1A_1$
West Ham	$D_3I_2A_3$
*Wolverhampton	$D_3I_2A_1$

Other Towns Making Daily Measurements of Smoke and Sulphur Dioxide

County Boroughs

Barnsley
Barrow-in-Furness
Blackburn
Bolton
Bootle
Burnley
Croydon
Doncaster
Exeter
Gateshead
Merthyr Tydfil
Newport (Mon.)
Peterborough
Preston
Reading
Salford
South Shields
Swansea
Tynemouth
Wakefield
West Hartlepool
Wigan
York

Representative Sample

(Asterisks indicate towns in which daily measurements have been made for some time)

Boroughs	*Classification*
*Accrington	—
Aylesbury	—
*Bedford	—
*Bexley	$D_2I_1A_2$
Bodmin	$D_1I_1A_3$
*Brentford and Chiswick	$D_3I_2A_2$
*Bromley	$D_2I_1A_2$
Chesterfield	$D_2I_2A_3$
Colne	$D_2I_1A_3$
Crewe	$D_3I_1A_1$
*Dagenham	$D_2I_2A_2$
Darwen	$D_2I_1A_2$
Enfield	$D_2I_2A_2$
Flint	—
*Gravesend	$D_3I_1A_1$
Halesowen	$D_2I_1A_2$
Harrow	$D_2I_1A_2$
*Hartlepool	$D_2I_1A_1$
Hereford	—
Heston and Isleworth	$D_2I_1A_2$
*Hornsey	$D_3I_1A_2$
Lancaster	$D_2I_2A_1$
*Leigh	$D_2I_1A_1$
Llanelly	—
*London	
Camberwell	$D_3I_2A_3$
Fulham	
Poplar	
Stoke Newington	
Wandsworth	
*Luton	$D_2I_1A_2$
Monmouth	$D_1I_1A_3$
Pudsey	$D_2I_1A_1$
Rhondda	$D_2I_1A_3$
Romford	$D_2I_1A_1$
*Scunthorpe	—
*Slough	$D_3I_1A_1$
Swindon	$D_2I_2A_1$
Tipton	$D_3I_2A_1$
*Tottenham	$D_3I_2A_3$
Twickenham	$D_3I_1A_2$
*Wanstead and Woodford	$D_2I_1A_2$
Watford	$D_2I_2A_2$
Wimbledon	$D_3I_2A_2$
Welshpool	$D_1I_1A_2$
*Wood Green	$D_3I_1A_3$
Workington	$D_2I_3A_1$
Worthing	—

Other Towns Making Daily Measurements of Smoke and Sulphur Dioxide

Boroughs

- Altrincham
- Ashton-under-Lyne
- Barking
- Barnes
- Batley
- Beddington and Wallington
- Bilston
- Castleford
- Chatham
- Cheltenham
- Chingford
- Dartford
- Dukinfield
- Ealing
- Eccles
- Edmonton
- Ellesmere Port
- Erith
- Farnworth
- Finchley
- Goole
- Guildford
- Harrogate
- Haslingden
- Hendon
- Heywood
- High Wycombe
- Hyde
- Ilford
- Ilkeston
- Keighley
- Kidderminster
- Kingston-on-Thames
- Leamington Spa
- Leyton
- London
  - Battersea
  - Bermondsey
  - Bethnal Green
  - Chelsea
  - City
  - Deptford
  - Finsbury
  - Greenwich
  - Hackney
  - Hammersmith
  - Hampstead
  - Holborn
  - Islington
  - Kensington
  - Lambeth
  - Lewisham
  - Paddington
  - St. Marylebone
  - St. Pancras
  - Shoreditch
  - Southwark
  - Stepney
  - Westminster
  - Woolwich
- Maidstone
- Malden and Coombe
- Middleton
- Morley
- Newcastle-under-Lyme
- Nuneaton
- Oldbury
- Oswestry
- Prestwich
- Radcliffe
- Rawtenstall
- Ripon
- Rochester
- Rugby
- Sale
- Shrewsbury
- Solihull
- Southall
- Spenborough
- Stalybridge
- Stourbridge
- Stratford-upon-Avon
- Stretford
- Sutton and Cheam
- Sutton Coldfield
- Swinton and Pendlebury
- Todmorden
- Torquay
- Wallsend
- Walthamstow
- Warwick
- Whitley Bay
- Widnes
- Willesden

Representative Sample

(Asterisks indicate towns in which daily measurements have been made for some time)

Urban Districts	*Classification*
Aireborough	$D_2I_1A_3$
Bedwas and Machen	$D_2I_2A_3$
*Bedworth	$D_2I_1A_1$
Brynmawr	—
Cheshunt	$D_2I_1A_2$
Church	—
*Clacton-on-Sea	$D_2I_1A_1$
Conisbrough	$D_3I_2A_3$
Coulsden and Purley	$D_2I_1A_1$
Cuckfield	—
Farnham	—
*Friern Barnet	$D_2I_1A_2$
Meltham	—
Potters Bar	$D_1I_1A_1$
Rickmansworth	—
Ruislip and Northwood	$D_2I_1A_2$
Sedgeley	$D_3I_1A_1$
Sidmouth	$D_1I_1A_2$
*Stanley	$D_2I_1A_1$
Street	$D_1I_1A_1$
Welwyn Garden City	—

Other Towns Making Daily Measurements of Smoke and Sulphur Dioxide

Urban Districts

Alfreton
Arnold
Atherton
Audenshaw
Beeston and Stapleford
Belper
Bentley-with-Arksey
Biddulph
Bingley
Bishops Stortford
Blaydon
Braintree and Bocking
Brierley Hill
Cannock
Carlton
Carshalton
Chadderton
Chigwell
Chislehurst and Sidcup
Coalville
Colne Valley
Crayford
Crompton
Cwmbran
Darlaston
Darton
Denton
Droylsden
Elland
Frimley and Camberley
Great Harwood
Harlow
Hayes and Harlington
Heanor
Hebden Royd
Hemsworth
Hoddesden
Horbury
Hornchurch
Horwich
Hoyland Nether
Irlam
Kenilworth
Kirkby
Leek
Letchworth
Loftus
Longbenton
Maltby
Merton and Morden
Newburn
Northfleet
Otley
Pontypool
Queensbury and Shelf
Ramsbottom
Rawmarsh
Rothwell
Royton
Saddleworth
Seaton Valley
Sowerby Bridge
Sutton-in-Ashfield
Tottington
Urmston
Waltham Holy Cross
Walton-le-Dale
Wednesfield
Whitefield
Whittlesey
Whitworth
Willenhall
Witham
Wombwell

Rural Districts

Alcester
Atherstone
Chelmsford
Chepstow
Dartford
Dunmow
Epping and Ongar
Eton
Llantrisant and Llantwit Fardre
Magor and St. Mellons
Meriden
Rotherham
Rugby
Settle
Shipston-on-Stour
Southam
South-East Derbyshire
Stratford-on-Avon
Tamworth
Thorne
Warwick
Wetherby
Wortley

Other Towns Making Daily Measurements of Smoke and Sulphur Dioxide

Scotland

County Councils
Angus
Ayr
Clackmannan
Dunbarton
Lanark
Stirling
West Lothian

Cities
Aberdeen
Dundee
Edinburgh
Glasgow

Burghs
Bathgate
Clydebank
Coatbridge
Dumbarton
Falkirk
Galashiels
Grangemouth
Hamilton
Hawick
Inverness
Kirriemuir
Lochgelly
Paisley
Port Glasgow
Stirling

Northern Ireland

County Council
Down

County Boroughs
Belfast
Londonderry

Boroughs
Ballymena
Lurgan

Rural District
Castlereagh

Discussion

Dr. W. C. Turner (Poplar), in opening the discussion said that in all scientific investigation, it was necessary not only for the collection of suitable information but for an experiment to be properly designed and this was particularly true with regard to the proposed National Survey. Much of the information collected in connection with the old survey had been obtained through monitoring specific nuisances and was, therefore, of purely local significance. In the National Survey areas had been divided into categories from which a random choice would be made from a number of authorities in each group. With suitable siting of instruments there would be less bias in the information obtained.

This was a critical time in atmospheric pollution research as it was necessary, and becoming increasingly urgent with the development of Smoke Control Areas, to obtain information relating to atmospheric pollution which would be valid as an indicator of datum levels of pollution on which future improvements could be assessed.

The President, in his masterly address, indicated that there were many aspects of deleterious effects from atmospheric pollution. The principal one as far as health was concerened was undoubtedly chronic bronchitis. The picture as to cause was far from clear for whilst there was a high incidence in the towns it was not entirely absent from the truly rural areas. What we wanted to know was whether the same factors were causative in both areas. Dr. Turner thought they were. Lord Cohen had drawn attention to a relationship with density of occupation in towns. This inevitably conjured up the picture of slums—small, damp, dark, overcrowded houses with a high incidence of respiratory catarrhal conditions amongst the inhabitants, particularly children and the elderly. These conditions, whilst mainly applicable to our industrial towns were, in fact, very similar to what was found in many old country cottages.

One thing we wanted to know was the effect of long-term exposure to both low and high levels of air pollution and to the effects of specific pollutants, and also what produced the acute effects when catastrophes arose as a result of air pollution.

The Department of Scientific and Industrial Research had recently developed instruments for automatic multiple sampling which would be available for demonstration at the meeting of the Standing Conference of Co-operating Bodies to be held in London next month. These instruments would be invaluable in this research.

One aspect of air pollution which must not be overlooked or underrated in its potentiality to produce " disease " was that due to naturally occurring substances in the air. Pollen was such a substance capable of considerable physiological effect, including abnormal respiratory responses which were very well-known. Another natural pollutant always present, therefore one to which exposure could not be avoided, and about which less was known, was the presence in the air of very large numbers of mould spores.

Structures exhibiting dampness which never dried out, particularly where damp proof courses were absent or defective, were invariably infected with fungi by upward growth from the mass of mycelium present in the soil. These fungi caused increased moisture movement and abnormal moisture retention in the structure. Air humidity of 80 per cent. saturation favoured their growth, and this figure was frequently reached in congested or overcrowded and ill-ventilated rooms used for sleeping particularly at night when air movement was often at a minimum. The dull diffused light within these rooms, and almost total absence of exposure to the sun or other source of ultra violet light, which is an inhibitor of sporulation, permitted, and in fact encouraged, the development of spores and fruiting bodies on the surfaces of the damp walls. The spores were discharged into the air of the room at frequent intervals and it was to these spores that certain unfortunate people were exposed for long periods of the day and night during their early lives. Susceptible individuals became sensitized and showed symptoms of allergy with typical increased fluid secretion and swelling of the cells affected. These spores, although of the same protein nature were much smaller than pollen grains. Many were in the 2 (micron) range or smaller.

The small particle size was of some significance in that they were capable of passing through the upper respiratory labyrinth with minimal signs of nasal catarrh so characteristic of hay fever. They passed deeply into the lungs, the mucosa of which became the target organ, with the production of a bronchiolar catarrh which upset normal respiratory physiology. The catarrhal condition sooner or later became infected with low grade pathogenic organisms which ultimately produced damage and permanent change in the lung substance, with alteration in its capacity to buffer and cope with the assault of the toxic substances present in air pollution produced from the incomplete combustion of fossilized fuels and other phases of human activity.

In Dr. Turner's submission this was a very important causal factor in the oetiology of bronchitis, which, once present, rendered the affected individual less able to cope with any assault by many of the other components of air pollution.

The occasional pathogenic infection produced the characteristic acute exacerbation of bronchitis with limited response to chemotherapy.

The authors were to be congratulated on the way the subject had been presented and he was sure that there would be a lively discussion.

Councillor W. A. Newman (Ipswich), began by saying that he was not enthusiastic over the Survey. During the last few years, he said, there had been endless Surveys, Reports, etc., on many matters, but they had done little except to provide good debating points. He hoped that this one would not follow the pattern of the Pippard Report which had lasted 10 years, the findings of which were still at the Ministry. Councillor Newman said that most people present knew what that meant. There appeared to be a common fault with all those Surveys: by the time somebody moved they were out of date. There was always one last hope—that by that time one could always have another Report to see what had gone wrong with the previous one.

S. Wald (National Coal Board) enquired the reasons for the blanks in the Classification Table. From the paper it appeared that this Classification was essential in placing the Boroughs in their proper groups, and it appeared therefore that in some cases at least some of the Boroughs had been classified on incomplete data.

R. E. Waller (Medical Research Council) said that he would like to thank Dr. Craxford and his colleagues for their clear description of the development of the National Survey. Having watched from a safe distance the gradual emergence of this scheme he fully realized that what they had told the Conference represented the distillation of an immense amount of study spread over several years.

He said that the Medical Research Council welcomed the advent of this survey, for it would provide them with a yardstick of the kinds of pollution which could be inhaled, applicable to any urban situation in this country. In the past they had received invaluable help from those enlightened authorities who had been making measurements of smoke and sulphur dioxide by the volumetric method for many years. Their smoke samples had been useful for the determination of carcinogenic compounds in the air and their smoke and sulphur dioxide results had been used in studies of the health of bronchitic patients.

Mr. Waller said that he would like Dr. Craxford to reassure them that the National Survey was by no means exclusive, since measurements by all local authorities would be welcome whether or not they had been selected for the main scheme.

Dr. P. X. Bermingham (Wellingborough), said that the Royal Sanitary Commission in recommendations made by them in 1871 referred to the problem of atmospheric pollution by smoke. That was many years ago and the problem was still with us. They were all aware of the fact that deaths from respiratory diseases in this country were the highest recorded in any of the countries making comparable statistics. In view of this, the slowness of progress with regard to tackling the overall problem of atmospheric pollution must be of concern to all. Our forefathers had fought for a pure and wholesome water supply and so we should today fight for clean and pure air.

He said that they recognized the fact that some of the larger cities and towns had commenced to tackle the problem of atmospheric pollution and progress had been made with smokeless zones, but asked if the same could be said for numerous other authorities throughout the country which had so far taken no action. Pollution of the atmosphere in many ways was like pollution that took place in many of the rivers today. The large bad effluents were not alone responsible, the many smaller bad effluents also had responsibilities, and in tackling the problem not only should the big polluting elements be taken into consideration, but also the lesser ones. Thus they should consider what action was being taken in the marginal areas. It had been found that respiratory deaths in some of those marginal regions were almost as high as those occurring in cities. It was essential if they were to have clean air that the marginal towns help in the cleaning up of the atmosphere. It should be an all out effort by all authorities throughout the country.

In the past many authorities had kept records of sulphur dioxide figures and also the results of readings from deposit gauges. If, as now, we were led to believe that these figures were not of value, then many people in the past had had a false sense of security brought about by those readings which in many of the marginal towns would have appeared to have been so low as to cause little or no concern.

T. H. Iddison (Dartford), pointed out that many local authorities, or groups of local authorities, had upon the advice of the Department of Scientific and Industrial Research been making measurements by the use of standard deposit gauges for many years and were beginning to wonder whether the measurements were of any use in assessing trends in deposition. He thought it likely that probably the most constant factor in the complex equation governing the rate of deposition was the rate of emission and that the figures obtained by analysis of the deposit gauge contents were largely a reflection of meteorological conditions. He thought that to suggest that local authorities should decide for themselves whether the information they were obtaining this way was commensurate with the expenditure involved, was to throw them back upon resources they did not possess. The interpretation of those figures required the services of a trained statistician and he thought that local authorities should be able to ask Warren Spring Laboratory for an interpretation of the statistics which they had amassed and an expression of opinion as to whether the use of the standard deposit gauge should be continued.

F. F. Ross (Central Electricity Generating Board) said that he had recently visited the Robert E. Taft Sanitary Engineering Centre in Cincinnati, and in support of the proposals for the survey of atmospheric pollution in Britain, he would like to state that in the American survey which was just beginning, no attention would be paid to the deposition of grit. Although dust deposition could be a considerable nuisance, it was regarded as of purely local significance. Precipitation gauges even had automatic covers which moved aside only during periods of rain, hail or snow.

Authors' Replies

Dr. Craxford replying to Councillor Newman, said that it was intended that the statistically chosen sample of towns should make measurements for the National Survey for a period of between three and five years. It would probably take the first year for the survey to settle down to steady working, and after that period it was planned to present interim reports year by year. In this way, advantage could be taken in the final stages of the work of constructive criticism that might be made of the first two or three years efforts. Since this was a joint investigation conducted by the Warren Spring Laboratory and the Local Authorities, and since Ipswich was in the representative sample of towns, he would remind Councillor Newman that this time he (the Councillor) was on the producing rather than the receiving end of the eventual report, so that the general public could rest assured that there would be no undue delay.

Mrs. Weatherley, in reply to Mr. S. Wald, explained that data published by the Ministry of Power were used to classify the towns according to domestic and industrial fuel consumption; some of the data referred, not to individual towns, but to groups of local authorities; further information is therefore required, *e.g.* as to the siting of industry in these groups, before the individual towns in the groups can be classified. These towns are drawn from all over the country and include large and small, industrial and non-industrial towns. In view of this, it was decided, after consultation with the statisticians, that no bias would be introduced into the scheme if for the purpose of selecting representative towns, the unclassified towns were grouped together to form an extra class, and selection of representatives made in the same way as for the other classes.

Dr. Craxford thanked Mr. Waller for his kind remarks about the survey, and in particular, for giving him this opportunity of re-emphasizing that all towns making daily measurements were in the national survey whether they were in the statistically-chosen sample or not. The two groups were complementary and both were essential; it was expected that very valuable results would come out of comparisons of the two.

Dr. Craxford said he was pleased Dr. Bermingham had mentioned marginal towns because these towns and districts were very numerous and were only marginal in the sense that it was impossible to estimate from existing knowledge the degree of air pollution in them. One of the major tasks of the National Survey will be to define the priority of such places in the general effort towards clean air. Dr. Craxford also said that while the deposit gauges referred to by Dr. Bermingham showed that there was little grit or dust nuisance they gave no information about the more harmful pollutants, smoke and sulphur dioxide.

Replying to Mr. Iddison, Dr. Craxford said that in any town smoke and sulphur dioxide were emitted from a vast network of sources, comprising the majority of domestic and industrial chimneys, and spread throughout the town and were ultimately removed by natural dispersive processes depending on meteorological and topographical conditions. The concentration of either of these pollutants was determined by the balance between the rate of emission and rate of dispersion. One of the main objects of the National Survey was to enable this complicated balance to be predicted for any town in this country and to do this the Warren Spring Laboratory would need all the expert help they could get from statisticians and meteorologists. Grit- and dust-fall, however, as measured with the deposit gauge, posed an altogether simpler problem. The sources of grit and dust in any town were relatively few, and were mainly industrial, and since these pollutants rapidly settled out of the air under their own weight the amount collected at any site depended mainly on emissions immediately up-wind of the gauge. By comparing data from a few strategically placed gauges and taking careful account of the wind-frequency for each month, it was not difficult to pin-point the major emitters, and if the amount of deposit was excessive, to use the evidence of the gauges to bring pressure to bear on the owners of the offending plant. Sophisticated mathematical analysis of the data is quite unnecessary and would indeed be inappropriate. Local knowledge is the key to the siting of the gauges and the interpretation of the data so that nobody is in a better position to deal with these matters than the Local Authority concerned. In cases of difficulty the Warren Spring Laboratory would of course be pleased to give any help and advice within its competence. It still would like to receive the data collected in this way so that rough national averages for various types of site may be maintained, as these averages are useful to local authorities as a standard of comparison for their individual data. The Warren Spring Laboratory does not ask local authorities to operate deposit gauges for the purpose of contributing to these rough averages, but it does ask these authorities operating gauges for their own purposes to send in the data as contributions to these averages.

Dr. Craxford added that Mr. Iddison would be pleased to know that following his suggestion of a year ago, the codification of deposit gauge sites for comparative purposes was now completed.

THE CERTIFICATION OF FURNACE OPERATORS

Report on the Reception of the Society's Proposals for a Bill

AT the first conference of the Society after the war, at Brighton in 1945, the compulsory certification of boiler operators was among proposals for new smoke control legislation then discussed. It is the only item among these proposals on which no further progress has been made.

This has been largely due to a lack of support for the legislation that would be necessary, although more recently there have been indications that views have been changing. The possibilities of a Bill have therefore been studied with much care by the Technical Committee of the Society. Their proposals, made in the form of a draft Bill, were eventually submitted to and approved by the Council of the Society and were published in the Spring, 1961, issue of *Smokeless Air*. It was made clear that the Society was not seeking to have the draft introduced into Parliament at the present time, but had issued it to promote discussion and to seek to secure public support—and especially the support of industry and the trade unions, without which it would be difficult to secure such legislation.

The draft was reprinted in leaflet form and copies have been distributed with a request for comment to many industrial bodies and unions likely to be interested. It was also issued to the Press.

This publication was made in March last, and insufficient time has elapsed for the receipt of all the comment we hope may be made. This should therefore be regarded as an interim report only, and the main reason for bringing it before this conference is in fact to continue to promote discussion and to hear the views of the delegates. For the benefit of delegates who have not previously seen it, the text of the Bill is reprinted as an appendix to this report.

The views expressed on the Bill, both by organizations and in the Press have so far been most favourable. There have been a few criticisms of detail but the principle of required certification has hardly been questioned.

Views of Organizations

The most important criticism of the Bill in general is that received from the Federation of British Industries. It is considered that the Bill falls between the two stools of clean air and improved fuel efficiency. "It does not in our view go far enough to achieve either objective, which would be better achieved by amendments to the Clean Air Act and the Factories Act, in so far as any further legislation is necessary," and:

> "If the intention is to ensure 'smokeless' operation of furnaces, as opposed to the present provisions which generally permit smoke of a density not greater than Ringelmann 2, the proper procedure would in our view be to sponsor an amendment of the Clean Air Act."

On the importance of training, the F.B.I. states:

> "We recognize that training is very necessary, but we do not consider that it should be confined to furnace operators. If efficiency is a main objective, all boiler and power plant operatives need training. We are not, however, in favour of compulsory certificates to bring this about. We prefer the general approach of the Factory Acts, where there is compulsion on employers to take on

competent persons for various tasks, although no definition of competence is in fact laid down. This method, however, works quite satisfactorily in other directions.

"We note that Schedule A exempts all fully automatic plants: the more automatic the plant, the greater the need for technical knowledge and skill in its operation. The exemption of plants below 1 million B.T.U.s an hour will exclude many works and commercial space heating plants which are often tended by unskilled labour, and furthermore, discharge their flue gases at comparatively low levels."

A comment from the Institute of Directors—which should perhaps be taken more informally—is that the draft Bill "seems to be an admirably, typically British compromise, with enough escape clauses to satisfy the most reactionary vested interests."

We have not received, so far, any comment from the National Coal Board at national level, but the proposals have been given active attention by the East Midlands Division of the Board and its constituent Areas. They draw attention to the special position of coal mines, referring to Paragraph 6 of the Coal and other Mines (Steam Boilers) Regulations, 1956, S.I.1772, which reads as follows:

> "The Manager of every mine shall make and secure the efficient carrying out of arrangements, whereby every Steam Boiler for the time being in use at the mine, is in charge of a competent person appointed by him for that purpose."

This provision must clearly be borne in mind when the proposals are re-examined, as it is hoped they will be.

The views of the Area Chief Engineers in the Division are generally favourable to the Bill, although it is pointed out by one that the industry's wages structure does not permit the payment of any incentive to the holders of these Certificates. "It will avail us little if the law says furnace operators must be certificated unless there is a sufficient incentive for men to want to become Furnace Operators."

Another writes: "Any compulsion to employ certificated boiler operators only would probably make the operation of our plants more difficult, due to the trouble experienced in persuading people to attend the courses."

The National Industrial Fuel Efficiency Service has not officially commented on the Bill, but it will be noted in the paper to be presented at this conference on their behalf by Mr. C. M. Opie, it is firmly stated:

> "Stoking should be recognized as an operation requiring skill and firemen should be properly trained, certificated and remunerated."

Support for the proposals has been given by the Advisory Committee for Fuel Technology of the Southern Regional Council for Further Education. The Committee is however "not fully in agreement with the exclusions of fully automatic plant and that in their opinion the definitions in Schedule A should be more closely linked to those used in the Clean Air Act." The suggestion is also made that the Royal Naval Vocational Training Course for Boiler Operators should be included in Appendix B and so recognized as issuing an appropriate certificate of proficiency.

Similar support comes from a Fuel Technology Committee of the South West Regional Council for Further Education, which says that they regard the proposals as "sound in principle and highly desirable in their aims." It is suggested that Clause 2 of the draft might be amended to define the meaning of "adequate supervision" so as to allow a trainee operator on a small installation to work without constant supervision of a certificated operator.

The Trade Union Attitude

The Trades Union Congress informs us that the Society's proposals have been given detailed consideration by their General Council, but that "they do not consider it desirable to depart from their previous policy on the matter, which is to encourage voluntary, as opposed to compulsory certification of furnace operators."

A different view is taken by the Engineer Surveyors' Association, which is affiliated to the T.U.C. The members of this Union include the people who inspect boilers throughout the country, and they have for a number of years been seeking to enlist the support of the T.U.C. in similar proposals. Resolutions urging the training and compulsory certification of stokers were submitted, without success, to the T.U. Congress in 1951, 1952, 1953 and 1956, and a resolution was again being submitted to the meeting in September this year. The Association intends to draw the attention of Congress to the fact that in 1881 it was the Trade Unions which requested H.M. Government to introduce a Bill on the lines advocated by both the Association and the N.S.C.A.

An Individual Comment

An individual letter of interest has been received from Mr. K. J. Smith, Chief Public Health Inspector, Heston and Isleworth. He considers it to be a pity that some of the worst offenders, namely, steam-operated mobile cranes and similar devices, would escape control, and makes further points as follows:

> " There would appear to be an advantage in deleting clause (*b*) of Schedule A. In my experience, automatic plants, if not properly maintained and adjusted, can produce a great deal of smoke and their maintenance calls for a degree of skill and training of a standard even higher than that needed for a hand-fired boiler, admittedly of a different and more technical nature than that needed for the physical handling of a shovel.
>
> " Experience shows that small steam raising plants often fall short of the degree of instrumentation usually regarded as standard and economically possible in large installations. It will be noted that Section 3 (4) of the Clean Air Act 1956, exempts only boilers rated up to 55,000 B.Th.U. per hour and the reference in proposed clause (*c*) to a rating of 1 million B.Th.U. per hour might be reconsidered so as to bring under control the smallest steam raising plant."

Press Comment

The publication of the draft Bill in *Smokeless Air* was reported in a number of technical periodicals and newspapers, mostly however without comment.

A newspaper view (*Sheffield Telegraph*, March 27th, 1961) was that it was a revolutionary idea—" that stokers may soon be compelled by law to be qualified before than can stoke. Overnight they would be lifted into the ranks of doctors and lawyers." The writer concluded: " Will stokers take kindly to the idea? Said one businessman to me: ' If I told the chap who stokes our furnace that he has got to be qualified, he'd leave at once '."

More serious mention was given, editorially, in *Fuel Efficiency* (April, 1961), which after summarizing the proposals, wrote:

> " It is to be hoped that this Bill will be carried further than discussion, both in the interests of fuel efficiency and clean air. There should not be too much difficulty in its implementation but care will have to be taken to avoid a shortage of boiler operators at the stage when the experienced man begins to disappear and the trained man takes over. It is not quite clear whether the ratings specified are to be taken for a complete plant or for each individual boiler. This could be quite important as even a small plant with a number of small boilers could create quite a large amount of smoke and, of course, waste a considerable amount of fuel."

Nearly two pages of *The Steam Engineer* (May, 1961) were devoted to discussing the Bill. The writer pointed out that the number of boiler operators taking the necessary qualifying certificate, particularly the Boiler Operator's Certificate, has not increased since the Clean Air Act, as had been hoped, and that in fact the number had been steadily falling off during the past year or two.

The article continues:

> " However, the general position in regard to industrial smoke emission is by no means completely satisfactory, and the problem is likely to grow more urgent as the National Coal Board's present sales campaign gets under way, as there is likely to be a swing back from oil to coal.
>
> " It is still suggested in some quarters that with modern up-to-date mechanical firing equipment, particularly when coupled to automatic combustion control, skilled supervision is unnecessary, and the plant can be left to its own devices. Personally, we disagree strongly with this view and consider that the more mechanized and the more modern the boiler plant, the higher level of operating personnel is required, even though the actual *number* of staff employed can be considerably reduced.
>
> " We have expressed ourselves in favour of the eventual compulsory certification of boiler operators many times in these pages, since we feel that if coal-fired boiler plant is to compete on equal terms with oil-fired plant there are three essential requirements, namely the correct type of boiler and firing equipment for the size and nature of the steam load, a consistent supply of the right quality fuel for the firing equipment used, and properly trained staff."

The Bill is quoted at length, and the article concludes:

> " In the main we are in agreement with the terms of this draft Bill with one important exception, namely the proposed exemption of ' all fully automatic plants ' under Clause (*b*) of Schedule A.
>
> " The meaning of this clause is not very clear, but if it is intended to relate to solid fuel-fired mechanical stokers fitted with automatic combustion control, then for the reasons already given, we consider this exemption to be both unrealistic and undesirable.
>
> " One practical difficulty is likely to arise in the implementation of the proposed Act, namely the judgment of the proficiency of an operator under Section 1 (*b*). Presumably in the majority of cases this matter would have to be delegated to N.I.F.E.S. or some other organization, as the majority of Local Authorities would not have the necessary staff to undertake the testing and certificating that would presumably be required.
>
> " In spite of these criticisms we feel that this draft Bill has a great deal to commend it, and we hope that the matter will now be energetically pursued with a view in putting forward a finalized Bill to Parliament in due course."

In conclusion mention may be made of a view that is encountered from time to time, although it has not been formally stated—namely, that the need for such legislation is now passing, and that although compulsory certification would have been useful when the hand-fired boiler was in greater use, the problem is diminishing and does not warrant legislation. Against this opinion is however the figure given by Mr. Opie in the paper previously mentioned —that there are today at least 50,000 operators without certificates working on boilers.

APPENDIX

Text of the Draft Bill as published in " Smokeless Air "

PREAMBLE

The objects of this Bill are threefold, namely:

(*a*) to secure a minimum standard of competence, obtained by training or by experience, of persons engaged in the duty of firing furnaces consuming fuel from which smoke could be produced;

(*b*) to facilitate the attainment of clean air in accordance with the objects and the provision of the Clean Air Act, 1956; and

(*c*) concomitantly with (*a*) and (*b*) above, to further the attainment of greater efficiency in the use of fuel.

THE BILL

1. On and after such dates as shall be prescribed by the Minister, by means of

Regulations, it shall be an offence for the occupier of any building or the owner of any plant installed on land to allow any person to perform the firing or other direct operation of any such furnace specified in Schedule A annexed to this Act, unless he possesses either

(*a*) one of the certificates specified in Schedule B annexed to this Act showing that he has received adequate instruction in and practical experience of the operation of fuel consuming furnaces:

or

(*b*) a certificate signed by or on behalf of a local government authority stating that he is known to have had adequate experience over a period of not less than one year in the operation of fuel-consuming furnaces and is proficient in that work.

2. This Act shall not apply to any person undergoing practical training in the firing of furnaces provided that he shall not be permitted to operate the firing of a furnace without adequate supervision.

3. If the occupier of any building or the owner of any plant to which this Act applies is unable to obtain the services of a person qualified in terms of Section 1, he may apply forthwith to the Local Authority of the area in which the furnace is operated for a certificate temporarily exempting him from the provisions of this Act provided either (*a*) that he can show that he has taken adequate steps to obtain such qualified person, or (*b*) that he has under training a person who has entered on a course of training approved by the institution concerned with candidature for one of the examinations prescribed in Schedule B.

A certificate issued in accordance with this section shall be valid for a period not exceeding three months in the first instance, during which period the occupier of any building or the owner of any plant may not later than one month before the expiry of its validity apply for an extension of its validity for further periods not exceeding in all one year.

4. No certificate issued in accordance with the provisions of Section 1 subsection (*b*) of this Act shall be issued after five years from the passing of this Act or such later date as the Minister may direct.

5. This Act shall apply to a self-employed owner or user of a furnace engaged in the operation of firing the furnace as it does to any owner or user of a furnace employing another person for the same purpose.

6. Any person aggrieved by the refusal of a Local Authority to grant a certificate under Section 1 (*b*) or Section 3 may appeal to a court of summary jurisdiction against such refusal within one month of the intimation thereof.

7. The Minister may from time to time by Regulation, amend the list of furnaces in Schedule A as he thinks fit.

8. Any person guilty of an offence under this Act shall be liable on summary conviction to a fine not exceeding £10 in respect of any day on which the offence shall have occurred.

SCHEDULE A

Stationary boilers of all kinds other than (*a*) those prescribed in para. 33 of the 2nd Schedule of the Clean Air Alkali, etc. Works Order No. 497 of 1958 and Order 1932 (S.105) 1958, (*b*) all fully automatic plants, and (*c*) furnaces rated at 1 million B.T.U. per hour or below.

SCHEDULE B

List of certificates of proficiency in the operation of Boiler Furnaces

Boiler Operators' Certificate and Intermediate Grade, Boiler House Practice Certificate of the City and Guilds of London Institute. Boiler Operators' Certificate of the Scottish Division of the National Society for Clean Air. Such other qualifications as may be approved by the Minister.

Discussion

S. N. Duguid in opening the discussion said that he was privileged to have introduced this subject at the Brighton Conference in 1945 and hoped that the proposed Bill would speedily be put on the Statute Book as he could not guarantee to come back in 1977 to continue the argument.

As one would expect the proposals had had a mixed reception but had not aroused any hostility. Those intimately concerned with the running of boilers and furnaces were enthusiastic, others damned the proposals with faint praise.

It was curious to note that the opinions of the F.B.I. and the T.U.C. appeared to be in close agreement. It is not often they were on the same side, in this case, the wrong one. Certification would lead to Boiler and Furnace Operators being recognized for what they were, skilled workers, and one would have thought that the T.U.C. would have supported the suggestion one hundred per cent.

It was pleasing to note the F.B.I. statement " We recognize that training is very necessary, but we do not consider that it should be confined to furnace operations. If efficiency is a main objective, all boiler and power plant operatives need training ".

The promoters of this Bill could not agree more heartily. Although only boiler operators were mentioned in the present proposals the Advisory Committee of the City and Guilds of London Institute, had written syllabuses of instruction, covering all other boiler and power plant operators.

Under the auspices of the City and Guilds of London Institute it was now possible to take the following examinations:

(*a*) Boiler Operator's Certificate; (*b*) Boiler House Practice; (*c*) Combustion Engineering Practice; (*d*) Power Plant Engineering.

One advantage of taking the training for a Boiler Operator's Certificate at a Technical School is that the men were encouraged to continue their studies and at Manchester there were boiler operators taking second- and third-year courses and passing the examinations.

There was no difficulty in training and examining the men who now, with the encouragement of their firms, came forward voluntarily, and this work would go on, so the question might be asked, Why resort to compulsion? The answer was, simply, that the work was taking too long.

Some 8,000 men had been trained but it was estimated that there were 50,000 more who would benefit by the training, and it was believed that a little mild compulsion, as suggested in the draft Bill, would rapidly increase the flow of students which lately had shown signs of diminishing.

Mr. Duguid went on to say that there seemed to be no mention in this report of the attitude of the men actually undergoing this educational process. He had been training boiler and furnace operators, engineers and smoke inspectors, etc., for over thirty years and it was mainly the enthusiasm shown by the men that had enabled him to keep on so long. He had yet to come across a single operator who had objected to the proposals in the draft Bill. This assertion was in flat contradiction to the opinion of the business man quoted by the *Sheffield Telegraph*.

It was most encouraging to note the support given to the proposals by the Journals *Fuel Efficiency* and *The Steam Engineer*. Colin Troup, the present Editor of the latter Journal and his father, John D. Troup before him, were pioneers in the advocacy of training all personnel connected with fuel burning plant and it was pleasing to see that their enthusiasm remained unabated.

A. Harrison Slade (National Coal Board) said no particular significance was to be attached to the fact that the National Society for Clean Air had not so far received any comments from N.C.B. headquarters.

He reminded the Conference that the National Coal Board had had a big hand in initiating the Furnace Operators' Certificate examination in its current form, which included a practical test, and that since its inception thousands of operatives throughout industry generally had become certificated.

He personally endorsed the views expressed by K. J. Smith, Chief Public Health Inspector for Heston and Isleworth, the Federation of British Industries, and the Editor of *The Steam Engineer* against the proposed exemption of fully automatic plants, on the grounds that those needed all the greater technical knowledge and skill in operation. *The Steam Engineer*, however, by inference appeared to discriminate as regarded exemption against solid fuel fired plant, and if so, Mr. Slade said he rejected this view, and asked the Conference to do so.

He said that much parrot talk was heard today claiming that automatic boiler plants could be left unattended and were safe without supervision. Many reports in the world press on boiler plant mishaps or worse, gave the lie to that, and they were not confined to automatic solid fuel fired plant. Lincoln had been right when he had said: " You may fool some of the people all the time and all of the people some of the time but you can't fool all of the people all the time ". He had been referring to politicians, but it might well have applied to automatic boilers.

Councillor C. A. Watson (Scunthorpe), said that in any comment he now made, he raised no question as to the absolute need for boiler operatives to be properly trained, nor of the need for furnaces to be operated by experienced and certificated furnace operators. The benefits to the Company concerned and to the aims of the Society were so obvious that any emphasis was quite unnecessary.

There were, however, a number of side-effects to the Bill, if the draft as published should be accepted and passed in its present form. His own experiences, such as they were, indicated to him that unless a dubiety in the contents of the Bill, or in other words one of the side-effects, were taken care of, there would be a gross injustice done to a number of people who had received training and had been certificated by the local authority under paragraph 1B as boiler operatives. His last employment had been as an Education Officer in a large integrated steelworks, and among his duties had been the compilation, the organization and the supervision of courses in boiler operating for employees of the firm. He had to say that generally speaking, the majority of the people employed on boiler operating, whether certificated or not, were well over the age of 40; indeed he had people of 55 and approaching 60 on courses to be trained as boiler operatives.

If the certificate issued under Clause 1B of the proposed Bill were not valid for the life of the possessor, (and it was important to note that this was not specifically stated in the proposed Clause), then Clause 4 would mean that a man who had been certificated by a local authority would not be able to continue his employment after the end of the five years mentioned in the paragraph. If such were the intention or the effect of the Bill, and the operator was no longer eligible to be employed as a boiler operative, then at the age of 50 or over there would be a cruel injustice done, in that at that age it would be difficult for him to find alternative employment, and in any case, this would lead to a fall in wages. He therefore urged that before the Bill was submitted to Parliament, steps be taken to safeguard the employment of all boiler operators who had been certificated under Section 1B of the proposed Bill.

Councillor C. C. Newsholme (Sheffield), said that he was wholeheartedly in favour of the certification of boiler operators, but he had been a boiler fireman, and boiler foreman, and all his working life had been at a colliery, and while Mr. Duguid anp the representative of the Coal Board had had some nice things to say about what the National Coal Board were doing, he felt that on this issue, they had failed. It was not sufficient to tell us of their provision of facilities for men to become certificated so long as they failed to provide the incentive by including a suitable grading inside the section of the wages structure known as the " craftsmen's agreement ". As a trades union branch secretary, he felt that this would end the apathy towards these courses in quite a few areas, and he sincerely hoped the Coal Board would take note of this.

Dr. W. R. Martine (Birmingham and British Medical Association), expressed his appreciation of the way in which Mr. Duguid had once again, and so ably, put the case for training and certification. If he were to be critical, he would like to draw attention to the ever-recurring nuisance from the vertical boiler and to ask for a more realistic approach. Many of them could more aptly be described as " smoke generators ", rather than as " steam generators ". A minimum of maintenance was normal practice and there were times when even a skilled stoker had the greatest difficulty in preventing emissions of smoke. Was not more than training required here. Considering the inconsistent quality of the fuel supplied to those boilers, and the pollution that could, and frequently did result, was it too much to ask for an extension of the current legislation whereby all such boilers having a rating above 55,000 B.T.U.s per hour should be fired by smokeless fuels, or alternatively, have oil-firing or be fired by mechanical stokers. Such a step, taken over the country as a whole, would materially reduce the pollution of our air.

W. J. Dickie (Federation of British Industries), stated that the Federation fully supported the objective, but disagreed with the proposals for achieving it. He pointed out that legislation had been in force in several States of the U.S.A. for many years, but pollution problems still remained. This legislation had been enacted previously as a safety measure.

C. Troup (John D. Troup Ltd.), in a written contribution stated that Mr. Slade was under a misapprehension when he suggested that the editorial in the May issue of their journal *The Steam Engineer* was intended to discriminate against solid fuel. That was certainly not their intention when writing the article, as they felt strongly that the exemption should be removed in the case of all boiler plant, whether they were fired by solid, liquid or gaseous fuel. It was true that when writing their editorial they were thinking particularly in terms of coal-fired boiler plant, since it was a fact that in the main the calibre of boiler operator tended to be higher in the case of oil-fired boiler plant, perhaps because of the potential fire and explosion risks, than in the case of coal-fired boiler plant, and therefore the need for the training and certification of boiler operators was probably more outstanding in the case of the latter type of plant. However, they felt that any type of boiler plant, whether coal or oil-fired, required a fully-trained operator, and preferably a certificated operator, and this was particularly so in the case of semi- or fully-automatic plant.

S. N. Duguid, replying to the discussion, thanked those taking part and expressed his pleasure at the absence of any severe criticism of the proposed Bill. Many useful suggestions had been made and he was sure that these would be examined carefully and embodied in the draught Bill if found practicable.

The view that " fully automatic plants " should not be exempted, expressed by A. Harrison Slade and others, was already receiving second thoughts. The " Practical/Oral test " on the firing floor was a vital part of the examination for the Boiler Operator's Certificate and it had been thought that the preparation of an adequate schedule of suitable questions to ask the candidate operating a fully automatic plant would be extremely difficult particularly should the operation simply entail the pressing of one or two buttons.

He thanked Councillor C. A. Watson (Scunthorpe), for his whole-hearted support of the Bill, and assured him that his valuable comments on the validity of certificates issued by local authorities would be carefully considered by the committee which had compiled the draft Bill.

Councillor Watson's comment on ages of students was most interesting as he had had the same experience. He found that the older men were second to none in their eagerness to acquire knowledge.

In reply to Councillor C. C. Newsholme (Sheffield), Mr. Duguid said that he was in full agreement with the provision of incentives for the men undergoing this instruction. Fortunately many employers had seen the justice of rewarding the men after they had obtained their certificates and he hoped it would not be long before all others followed suit.

To give one concrete example, the Minister of Health has encouraged the boiler firemen employed at the Hospitals throughout the country to train and sit for the Boiler Operator's Certificate. The successful candidates immediately receive a rise in wages.

Mr. Duguid thanked Dr. W. R. Martine (Birmingham and British Medical Association) for his long and continued support and for drawing our attention to the fact that there were a number of fuel burning plants in existence that could not be operated smokelessly and efficiently. Whether anything could be done to alter this state of affairs by legislation required some thought but it was obvious that the best trained stoker in the world could not cope satisfactorily with a badly designed or maintained plant.

In reply to Mr. W. J. Dickie (Federation of British Industries), he suggested that if the legislation in the U.S.A. had not been effective it was due to the fact that the Americans had omitted to set up courses of instruction such as had been running in this country for many years. Mr. Kaiser, New York, admitted at our Diamond Jubilee International Conference, London, 1959, that they had no courses comparable to ours in the U.S.A. and they relied on building efficiency and smokelessness into the plant. It was evident, went on Mr. Duguid, that we needed their legislation and they need our educational methods.

In conclusion Mr. Duguid said that the debate had left him optimistic as no case had been made out against the proposed Bill, and if it were found practicable to meet all the valuable criticisms and suggestions made, the Bill would in no way be weakened.

STATEMENT ON SMOKE FROM DIESEL VEHICLES

INTRODUCTORY

1. Following the papers and discussion on road vehicle pollution at the Harrogate Conference, 1960, the Technical Committee has held a series of meetings on the subject, including discussions with representatives of the principal national road transport organizations and others. Their conclusions, which have been discussed with the Parliamentary and Local Government Committee, have been approved by the Executive Council.

2. There is widespread public concern, often strongly expressed, over road vehicle pollution, and especially over the dark smoke from diesel vehicles. With the growing volume and density of road traffic the problem is becoming increasingly serious. Although this statement is concerned with pollution from diesel engines it should be emphasized that, as far as the effects upon health are concerned, the exhaust fumes from petrol engines—containing carbon monoxide, aldehydes and lead compounds—may possibly be more harmful, and they at least warrant much more investigation than they have received.

3. The reasons for public complaint about diesel smoke and gases, and the demand for more effective prevention, are: (1) Possible danger to health. Although there is so far no firm evidence on this, and many statements that have been made appear to be exaggerated, the possibility of such dangers, even if only in certain circumstances, cannot be ruled out. (2) Danger to road safety from the obscuration of visibility and the sense of impatience suffered by the drivers of following vehicles. (3) The deposition of black and greasy dirt on other vehicles and their passengers, and on roadside buildings, pedestrians, and vegetation.

4. The extent of the nuisance on roads carrying much diesel traffic is shown by recent investigations on the Archway Road, North London, by the Hornsey Borough Council in conjunction with the Warren Spring Laboratory of the D.S.I.R. (see *Smokeless Air*, Autumn, 1961). The measurements recorded show that the smoke pollution level on the road is on the average many times greater than the smoke pollution of the surrounding district.

5. It is concluded that the nuisance, in streets and roads frequented by diesel vehicles is most serious, and that present control or preventive measures are failing to reduce or even to check its growth.

6. The new Regulation to prevent the excess fuel device being used while a vehicle is moving is welcomed as being likely to remove one notorious cause of excessive smoke emission.

THE PRESENT POSITION

7. The present method of control by the Police, under the Road Traffic Act and Regulations, is based on it being an offence to emit smoke, etc., that is likely to cause damage, injury or danger. This has had, at best, only a limited effectiveness and clearly is designed to deal only with excessive emissions for which a conviction can be reasonably expected.

8. To strengthen these existing powers, proposals have been made for, and attention has been given to, the use of meters, instruments or shade charts to measure smoke density; and for it to be an offence to exceed a stipulated limit. Although instruments for measuring smoke

from a stationery vehicle under test are in use and are valuable, the measurement of smoke from a moving vehicle, with a view to legal action, appears to be technically and administratively uncertain, and, if the procedure proposed below is adopted, to be unnecessary.

9. Devices for the removal of smoke after its formation (and for the removal of unburned hydrocarbons from petrol exhausts), by catalytic action, or after-burning, have been much discussed, especially in the U.S.A. Although certain devices have been accepted for testing by the Californian authorities (with a view to making their installation obligatory) none has so far been approved. Although such devices might have some value, we are doubtful whether they could be regarded as more than secondary to measures for promoting correct combustion and engine usage. Similar reservations can be applied also to the use of fuel additives and the discharge of exhaust gases at the top of the vehicle.

10. We have found that it is generally agreed that the principal reasons for smoke emission from diesel vehicles are: (1) failure to maintain the engine or to operate it in an efficient manner; (2) over-loading of the vehicle in relation to the power of the engine, and (3) improper use of the engine or vehicle. The engine should be so maintained and operated that, as in any other fuel-burning equipment, as close an approach to complete combustion as is possible is obtained. It is therefore concluded that control for smoke prevention should be directed towards ensuring that these necessary conditions are secured, rather than simply by making it an offence to emit smoke.

11. We are of the opinion that the best practicable approach to the question of ensuring correct maintenance is that already used by the Ministry of Transport, whose Examiners have powers to enter and inspect vehicles, and to enter premises " for the purpose of ensuring that goods vehicles are maintained in a good and serviceable condition." They also have powers to prohibit the use of a vehicle for the carriage of goods or passengers which (in the Examiner's opinion) is likely to constitute a danger to other road users. Since the Regulations require that every motor vehicle shall be so constructed that no avoidable smoke or visible vapour is emitted therefrom, the Ministry's Examiners can, and in practice do, prohibit the use of badly smoking vehicles. At present although this control may not be exercised as widely or as strictly as may be necessary, the system appears to be potentially the most effective, equitable, and constructive form of control available. As we envisage it, it is similar to the powers recently brought into force under which a vehicle can be halted and checked for brakes, steering, lighting, etc.

PROPOSALS

12. We therefore propose:

(i) That the present practice of vehicle examination by Ministry of Transport Examiners be expanded and applied more strictly, if necessary by stages, to whatever extent may be necessary.

(ii) That the Ministry's staff of Examiners be increased as may be required, with the setting up of training courses if sufficient qualified persons are not available.

(iii) That co-operation between the Examiners and the Police in this form of control, which we understand already exists, be developed further; and that attention be given to the difficulty that arises from the fact that an Examiner is not empowered to halt a moving vehicle (although he can serve a notice on one that is stationary). The powers that are required should, in general, be shared by Police and Examiners.

(iv) Attention should also be given

to the difficulties arising from the lack of powers to deal with empty goods vehicles.

13. The opinion, or visual judgment, of the Examiner suffices, under present practice, for the purpose of stating that a maintenance test is required. This is similar in principle to the visual judgment of an experienced Inspector in the case of chimney smoke emissions that is explicitly permitted in the Clean Air Act (S.34(2).). In the present case however the notice is not in the nature of a summons for an offence, and an offence arises only in cases of obstruction or failure to comply with a notice (when in our view it should be answerable by the owner to hirer of a vehicle). We see no reason why this practice should not continue under the expanded control proposed, thus obviating the need for measurement instruments.

14. It has been impressed upon us that even well-maintained vehicles may emit excessive smoke, especially at starting, accelerating and hill-climbing, if they are overloaded for the power of the engine. The present maximum load figure is not related to the engine and is not relevant. It is therefore proposed that the maximum load for any type or class of diesel engine should be determined either by the application of an agreed general formula based on horse-power, or by the testing and grading of each type or model of engine. It should then be an offence for the overall load to exceed the permitted maximum. The practice of London Transport, for example, in under-rating their buses by about 10 per cent. of the engine rating, is one that might be made obligatory. The ways and means for setting the standards required or of testing classes of engine need to be studied and it is conceded that there may be difficulties to overcome. But we believe that it is essential that the principle proposed should be adopted and applied as soon as possible.*

15. Further proposals, related to those outlined above, are that steps should be taken to encourage the regular and systematic servicing of all diesel vehicles on the lines adopted by some of the larger and more progressive fleets. It is our view that the proposals we have made would serve as a direct and valuable stimulus in securing proper maintenance and the avoidance of overloading. A certificate with respect to smoke prevention should be required on the sale of all used diesel vehicles.

16. Educational and publicity activities, addressed to the owners and drivers of vehicles, on the importance of maintenance, avoidance of overloading and the dangerous and harmful effects of smoke emission, should be considerably expanded. The Society would be glad to have the opportunity to assist in such work.

CONCLUSION

17. We recognize that our proposals involve technical and administrative difficulties that call for careful study, and that their application will cost money. The seriousness of the problem however fully warrants such study and expense.

18. The Society would welcome an invitation from the Ministry to meet a deputation to discuss the proposals made. As the problem affects the well being of the community, which is the concern of the Ministries of Health and of Housing and Local Government, and the Department of Health for Scotland, the interest of these departments in the proposals would also be welcomed.

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* An alternative to control by limitation of load that has been suggested to the Society is a regulation to require that the fuel stop (which controls the injection of the fuel) should be sealed at a specified point below that at which smoke formation begins to occur. In the absence of proper maintenance deterioration of conditions would narrow this margin, but until this has occurred it is stated that smoke production would not take place even with overloading. One form such a regulation might take would be to prohibit the use of a vehicle with a maximum available power output of say more than 90 per cent. of the rated output as claimed by the engine manufacturer.

Discussion

Stanley E. Cohen, Chairman, in introducing the statement, asked the Conference to give approval to the Executive's action. He said that there was always a big gap between making such proposals and seeing them put into action. The Society had a great deal of hard work to do in this matter, he continued, and it could be materially helped if all the people who were so rightly indignant about diesel smoke, and who wrote letters of protest to the Press about it, were to become members of the Society or would make donations to its funds.

Arnold Marsh, Director of the Society, explained why the statement had been introduced at the end of the session and had not been included in the printed programme. The work leading to the statement had been in progress over a series of meetings during the year and it was not until September, long after the Conference Programme had been published, that it was seen that it would be possible to place a statement before Conference. It had in fact received the approval of the Executive Council as late as September 8th.

The statement had been prepared after a series of meetings of the Technical Committee, in the last of which it was joined by the Parliamentary and Local Government Committee. At two of the meetings invitations to attend were sent to various road organizations and individuals. To have acknowledged their very helpful co-operation in the statement itself might have associated them too closely with views they might not necessarily endorse, but the opportunity should be taken of acknowledging their interest and help. They included representatives of London Transport, the Society of Motor Manufacturers and Traders, the Municipal Transport Association, the National Road Transport Association, the Road Haulage Association, the Public Transport Association, the B.P. Research Centre, and the Transport Department of the North Thames Gas Board. In addition the Committee had the co-operation of Dr. P. J. Lawther, of the Medical Research Council, and Mr. Douglas Lister, the contributions of both of whom to the subject were well-known to the members of the Conference.

J. T. Turner (National Road Transport Federation) recalled that at the Conference at Harrogate this question had been given an adequate airing and that as a result the National Road Transport Federation had joined the Clean Air Society and he had attended at least two meetings of the Technical Committee for discussions. At those meetings the Society discussed the problem in a reasonable manner and he felt they were proceeding along the right lines. Then, without warning, this statement on diesel smoke was suddenly published and Mr. Turner had seen it, for the first time, only four days before the Conference.

Despite assurances by Dr. P. J. Lawther, Director of the Medical Research Council's Group for research on atmospheric pollution, in paragraphs 2 and 3 reference was made to the possible danger to health. There was no proof of this. Item 5 said that the nuisance was most serious in streets, but there was little or no evidence to substantiate that statement. Item 7 said that the present powers were restricted to excessive emissions of smoke, but that was not the case.

In paragraph 10 the principal reasons for smoke emission from diesel engines were listed. Mr. Turner said that undoubtedly No. 1, lack of maintenance, was the prime reason. The diesel engine properly maintained and operated gave as near complete combustion as was possible. It was the only engine permitted to be used in the mines in many countries.

There had been a steady increase in the number of diesel engined vehicles in use, but at the same time there had been a marked improvement in the maintenance of those vehicles, and the number of vehicles emitting black smoke was very small. Heavy commercial vehicles were often away from their base for periods up to seven days and sometimes a vehicle on a long journey suffered some minor defect which caused it to emit black smoke and the driver of the vehicle might not even be aware of this. In general, commercial goods and passenger vehicles were well maintained, being subject to spot checks and regular scrutiny by representatives of the Ministry of Transport.

Reference had been made to the tests on the hill in Archway Road, but Mr. Turner contended that this was not a fair point at which to hold a test. That road was the main artery out of London, some 90 per cent. of the commercial vehicles from London proceeded northwards and a considerable proportion of those vehicles travelled along Archway Road.

Accordingly, together with other traffic, the road became very congested. Congestion led to overheating and as a result you might get fumes and some smoke from diesel engines, but that would not occur if the road were not so congested.

Mr. Turner reminded the Conference of the offer he had made to the Executive of the Clean Air Society last year, to undertake a test on any part of the M.1 for a period of say twelve hours and total the number of diesel vehicles travelling the road, and also recording the number of offenders in respect of black smoke. He said that this would not be many.

Coming to the question of the proposals in paragraph 12, Mr. Turner said he would like to know how one could apply a spot check or the regular inspection of vehicles more strictly, accepting the fact that it was undetraken properly by the Ministry of Transport qualified engineers at present. There was already full co-operation between the Police and the Vehicle Examiners and the present law was effective and adequate. Mr. Turner said he had read with alarm the proposal that persons other than policemen in uniform would be empowered to halt a moving vehicle and did not think that the general public would accept such a state of affairs having regard to some of the tragic happenings in cars in recent months. He did not feel that there was any need for additional legislation. He said that the law as it stood at present was adequate to deal with the offenders, and where a prosecution was justified then the Police should take the necessary action. The way to obtain improvement in this matter was by education and Mr. Turner told the Conference that his Organization frequently called the attention of its members to this annoying problem and he thought all would agree that there had been a substantial improvement.

P. Draper (Shell-Mex and B.P. Ltd.) said that having read with interest the Statement which set out the situation on smoke from diesel vehicles so clearly he felt, as a diesel engineer, that an important point had been overlooked.

He thought the best way of stating his point clearly would be to explain in non-technical language how a well-maintained diesel engine could be made to produce no smoke however much it was overloaded. When the accelerator pedal of a diesel vehicle engine was depressed, it did not open a throttle as in the case of the petrol carburettor engine, but it permitted more and more diesel fuel to be injected into the cylinders to give more and more power. If this process were not limited, so much fuel would be injected ultimately that it could not burn completely and smoke would be produced; thus the manufacturers of diesel engines provided a stop on the fuel pump system, which could be set either at the point at which smoke became just visible or at a position a bit earlier so that there was a little margin in hand. This technique would limit the maximum output of the engine by a small amount; for instance in the case of London Transport maximum power was reduced by 10 per cent.

Once the stop had been correctly set and provided the engine was in a well-maintained condition, it was not possible for any action of the driver to cause smoke to be emitted from the exhaust. This meant that the weight of the vehicle was of no consequence regarding smoke emission, but that the driver must change gear earlier than he would if a larger engine were fitted.

Nevertheless, overloading a vehicle or underpowering it was generally bad practice from several aspects. For instance it provided a reason why engine makers and operators were loath to set a fuel stop with adequate margin, and might tempt operators to maladjust the stop to run into smoking conditions in order to obtain a little more power. Mr. Draper suggested that the proposal in paragraph 14 to the effect that maximum load for any type or class of diesel engine should be agreed by general formula based on horse-power was not a prime factor in solving the problem. He thought the solution, therefore, would be to ensure that the fuel stop was correctly set for the small margin in hand to allow for a degree of deterioration of the engine during operation.

Arnold Marsh, in a written reply, said that some of Mr. Turner's criticisms did not seem to be justified. Thus he was critical of the statement mentioning that one reason for public complaint was the possible danger to health. There was no doubt that this was in fact the main reason for public complaint, and it had been hoped that it would be clear that the purpose of the reference to health that had been made was to deflate the misleading and exaggerated opinions that were so often made.

Mr. Turner continued by saying: "Item 5 said the nuisance was most serious in streets but there was little or no evidence to substantiate this statement." The paragraph actually said that "the nuisance in streets and roads frequented by diesel vehicles is most serious ". The Archway Road was a well-known case in point, and Mr. Turner had supplied the evidence for which he was asking by saying that this was why it became very congested.

On the proposals made, and criticized by Mr. Turner, the main point was that the present practice of the Vehicle Examiners should be expanded to whatever extent might be necessary to make it fully effective. That it should be applied strictly, by stages, simply meant that the standards of what was permissible should gradually be raised. It was not proposed that persons other than policemen in uniform should be empowered to halt moving vehicles. What was desired was that the present co-operation between the Police and the Examiners be very considerably extended.

On Mr. Draper's contribution it would be noted that this had been considered and accepted and had been added to the statement in the form of a footnote.

It should be added that a meeting between representatives of the Society and of the Ministry of Transport was held on December 8th, 1961, and that as a result of a most constructive discussion the problem was being further studied by the Technical Committee.

OPERATION OF THE CLEAN AIR ACT: INDUSTRIAL ASPECTS

I. THE LOCAL AUTHORITY VIEWPOINT

*J. W. Batey, D.P.A., M.I.Mar.E., M.R.S.H.**

THERE is no doubt but that the Clean Air Act is proving a useful tool for fighting air pollution. Local Authorities have been virtually powerless in the past and the spectacular change which is notable in our great cities is not due to any change in the Local Authorities' desires and ambitions to clear up the air of their areas; it is not due to any change of heart within industry to clear up the air in our cities; it is solely due to the fact that Local Authorities have now been given some power over some of the more obvious aspects of atmospheric pollution.

Section 1

Section 1 works fairly well, although it is becoming obvious that some firms are well aware of the defences written into the Act and are prepared to use these defences in the first instance. The lighting up defence ought to be overhauled and there should be no difficulty in setting time standards for lighting up a furnace. I have no doubt that firms would soon appreciate the value of gas, electric or oil ignition for their furnaces, if a limit of say, 10 minutes or 15 minutes, were set for the lighting up period.

Section 2

The exemption procedure has been remarkably successful, for no matter how much legislation is available to tackle atmospheric pollution, there must be a time factor involved, in order to preserve a realistic approach to the problem. Legislation is not a magic wand which, when waved on a specific date, will cause pollution to disappear. Many unusual and difficult problems have been encountered in curing smoky chimneys, but all these problems are yielding to study and to the necessity of finding a cure by 1963.

Steel manufacturers, large and small, preached a doctrine which, in brief, stated that a reducing atmosphere was essential to the steel industry and, therefore, that the furnace atmosphere had to be starved of oxygen with black smoke as the inevitable concomitant at the chimney top. This argument is never heard today and the excuses for making smoke are now confined exclusively to the three defences in Section 1 or to a workman who is not doing his duty.

The exemption clause was also necessary for those firms who had to incur a very large expenditure to make their premises smokeless. In some cases, programmes have had to be spread over a number of years, not only on account of the financial implications, but also because of the shortage of labour and equipment. The twelve months maximum period for exemption has been particularly useful in that it calls the attention of a firm to the fact that something still remains to be done when the Exemption Certificate has to be renewed. The usefulness of this section is exemplified when the exemptions granted by my Local Authority are examined as follows:

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* Superintendent Smoke Inspector, Sheffield and District Clean Air Committee.

Taking one firm as an example.

In May, 1958, exemption was granted for 59 furnaces served by 22 chimneys. In May, 1959, exemption was granted for 24 furnaces served by 13 chimneys, and in May, 1960, exemption was granted for 11 furnaces served by 5 chimneys.

Section 3

Section 3, which controls the installation of new furnaces, is not understood by industry or by the architects. It is doubtful if any furnaces which are hand-fired by bituminous coal are being installed today, and this is about the only type of furnace which could be covered by Section 3 (1). Nonetheless, this Section might be looked upon as a useful " long stop " and as such, serves a useful purpose. As far as is known, no prosecutions have been instituted under this Section.

Section 3 (2), sometimes called the prior approval section, offers obvious difficulties to a Local Authority who might be asked to approve a furnace installation. The smaller authority cannot be expected to have a staff who are sufficiently well versed in design and combustion problems, to advise the approval of a particular type of furnace and even the large authorities, employing a specialist staff, might still have difficulty in assessing and approving furnaces which are probably designed for a particular and special job or application. Even a quite conventionally designed furnace can sometimes be the subject of unexpected difficulties and it appears to me that Local Authorities are generally discouraging the prior approval of fuel burning appliances. A joint committee of experts have, in some cases, been formed to deal with such applications but the volume of work which they have had to deal with is probably quite small.

Section 4

This Section deals with smoke density meters and is not of major concern to the Local Authorities, since the Minister has not made regulations and the fitting of smoke density meters is not, therefore, mandatory. A number of firms manufacture this type of instrument and these firms can be relied upon to press their claims without the Local Authority or the Minister doing the work for them. There is no doubt that such instruments are particularly useful where the chimney top cannot be observed by the fireman, and some Local Authorities ask for these instruments to be fitted before giving approval to the plant concerned. Such instruments require careful and regular maintenance if they are to produce a satisfactory result and not become yet another dial which is obsolete and redundant.

Section 5

This Section, which deals with grit and dust from chimneys, is probably the most difficult Section to apply in the whole of the Act. It gives no standards from which the Local Authority can work and it gives " any practicable means defence " to the occupier. There is no good reason why standards of grit emission should not be laid down under this Section, and it is suggested that such standards ought to be related to the capacity of the furnaces. In this way experience could be gained, and if the standards were too low or too high, they could be altered by Parliament. The industrialist must be clearly informed on his responsibilities and the standard required. Until these two requirements are met, progress will be difficult and uncertain.

Section 6

This Section makes mandatory the fitting of grit and dust arrestment on pulverized fuel plant and on plant burning one ton of fuel per hour or more. Apart from power stations, plant of this nature is not being installed today and the Section is quite valueless. It may be remembered that when the Clean Air Bill was going through Parliament, the figure of one ton per hour was fixed at ten tons per hour and it took considerable pressure from interested parties to get the more realistic figure of one ton written into the Act. Even so, it is suggested that there will be no major improvement in grit emissions throughout the country until the one ton is again divided by ten and brought down to two hundredweights. A sample survey of the Sheffield and District Clean Air Committee's area was made in an effort to assess the effectiveness of this Section, and it was found that only two furnaces approached the one ton per hour limit of fuel consumption. What was true then is equally true today, and until the limit of one ton is brought down to a realistic figure this Section will be valueless to most Local Authorities.

Section 7

This Section has not been implemented, but it is considered that a useful purpose could be served if Local Authorities had the power to insist, in suitable cases, in grit measurement being taken on particular furnaces. The old method of using petri-dishes, or pieces of glass coated with vaseline, to catch the grit coming from a chimney are haphazard and unscientific.

Section 10

This Section is proving most useful, particularly in the larger cities and towns, and although many architects appear to object to high chimneys, the work of scientists such as Nonhebel and Bosanquet has proved their efficacy in normal circumstances.

Section 18

This Section has had considerable effect on the control and management of spoilbanks in the ownership of the National Coal Board and the good work now being achieved could well be codified and issued as a Memorandum. Such a Memorandum would be a most useful tool to put into the hands of all Local Authority officers.

Section 22

Why such places as Hospitals and Barracks should be out of the control of the Local Authority is not known. It is as pointless as it is mysterious. There is no mystery in the smoke and grit which some crown properties can produce—and no mystery about the cures. The basic necessity is the application of Section 1 of the Clean Air Act.

This brief review of some of the more important industrial Sections of the Clean Air Act shows that it is proving a useful tool in combating the smoke menace. It could be strengthened most effectively by increasing the strength of Section 5, but for other aspects of Air Pollution further knowledge—and a new Act—will be necessary.

II. MANUFACTURING INDUSTRY AND THE CLEAN AIR ACT

W. J. Dickie, A.M.I.Mech.E., M.Inst.Fuel.[*]

Introduction

THE industrial approach to the air pollution problem can be summed up as a due recognition of the need for correcting a social evil but a regard for the limitations imposed by the current state of technical knowledge and economic circumstances.

Strenuous efforts have been made to comply with the statutory requirements and it is plain to all that a marked improvement has been effected. This has only been achieved at a high cost, and it has been achieved during a period when order books were full, production was being expanded to meet the need for exports, and new manufacturing processes were being developed.

Some problems still remain and further research and experiment is proceeding in an effort to solve them.

1. The Industrial Approach

It cannot be denied that there was great scope for a reduction in the degree of pollution from industrial chimneys prior to the passing of the Act. It must be realized that Britain's industry has a long history and was grounded on coal, and what is more important, cheap and readily available coal, which engendered a policy of profligate use without due regard to the consequences. This was handed down as a legacy throughout the years of industrial expansion and for a long time little heed was paid in the design of equipment to the angle of air pollution: equipment was considered satisfactory provided it suited manufacturing requirements.

Rising fuel prices and efforts to improve efficiency, spurred during the war years by shortage, effected a gradual improvement, and there is no doubt that this would have continued at an increasing pace.

The smog disaster of 1952 showed however that something more than this was required and industry consequently found itself responsible for complying with the statutory measures of the Act.

There is a body of opinion that the Act does not go far enough, that the requirements should be stricter and more rigorously applied. To hold this view is to ignore the complexity of the problem; this problem can only be solved entirely, provided we know how to solve it, and possess the necessary means. Throughout the formative stages of the Act, it was made clear that industry recognized the need for correcting the social evil of atmospheric pollution, and was fully conscious of its obligations, but that there must be full regard for economic circumstances and the limitations of current technical knowledge. The Act wisely accepts this and bases its approach on realistic and economic lines.

2. Publicity

As the premier body representative of manufacturing industry it behoved the Federation to take all practicable steps to inform its members of their obligations under the Act and afford every possible assistance in meeting them. As a first step a series of meetings were held in all the principal industrial centres of England, Scotland and Wales for this purpose. The high rate of attendance at these meetings indicated that industry was anxious to tackle the job urgently and efficiently. Numerous questions were raised and many misunderstandings were cleared up on the spot, others were solved by visits of a technical officer to the site. Follow-up meetings were held about a year later with the objects of explaining developments and encouraging members to interchange their experiences. At all these meetings members were advised to co-operate fully with Local Authorities.

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As a background to the programme, a comprehensive booklet was published which explains the requirements of the Act and gives advice on meeting them in the more efficient manner. It also includes lists of firms manufacturing the equipment likely to be required. This booklet has proved very popular, over 8,000 copies having been distributed to date.

Details of the steps taken and the results achieved by certain individuals are included in Section 5.

3. British Standards Institution

Industry has co-operated fully with the British Standards Institution in the preparation of the various standards prepared as adjuncts to the Act. The Federation would like to pay tribute to those who gave so much of their time for this purpose, and to those firms who freely loaned their equipment, and also those who made their plants available for the various tests that were required.

The information published by the B.S.I. has proved most valuable, some of the publications being the first examples of their kind in the world.

4. Difficulties Experienced

Local Authorities generally have exercised restraint in using their powers under the Act. For the first few years they have been content to issue warnings to offenders, and as the review carried out by your Society in 1960, showed, only about 1 per cent. of the known cases where a prosecution might have been initiated has resulted in prosecution. This attitude is fair and reasonable in view of the complexity of the subject.

A number of misunderstandings have of course arisen but the only major difficulty has been the interpretation of the requirements governing the height of chimneys for small plants. Investigations following several complaints showed that a number of Local Authorities asked for greater heights than the circumstances justified. Some appeared to have interpreted too literally Appendix VI of the report of the Committee on Air Pollution (Beaver Report)[1] and to have ignored the recommendation that discretion must be exercised for small installations. Some further investigation was clearly necessary and the Federation set up a working party of experts to examine the problem and make recommendations. This is described in detail in Section 6.

Some problems have occurred in connection with the disposal of works refuse. Difficulties have arisen in a few cases due to lack of appreciation of the nature of the materials being burnt and in others from the use of unsuitable incinerator equipment. Equipment manufacturers willingly investigate combustion problems associated with difficult materials and it is wise to consult them before installing a plant to deal with a difficult waste.

There are signs that the refuse destruction problem, although not acute at present, will become more serious in future years, and it would appear to be desirable to tackle it on a national basis rather than to continue to rely on individual effort.

5. How the requirements of the Act have been met

The measures adopted have varied widely, they range from conversion to liquid fuel and mechanical stoker firing, to complete replacement of plant.

The problems associated with some industries are particularly acute and have called for considerable research and much higher rates of expenditure. The efforts made and results achieved in certain high fuel consumption industries are described in detail in the following paragraphs.

(*a*) *The Glass Industry*

The two main features of the progress made in the glass industry are improvements in the manufacture and use of producer gas and large scale conversion to oil firing. It would be wrong to state that the measures have been taken solely to comply with the requirements of the Act. The Act has, however, accelerated decisions which would have been taken in due course for technical and economic reasons.

(i) Fuel: Table 1 shows the rate of increase in glass production and fuel oil consumption from 1954 to 1960 inclusive. As a very broad generalization, it could be estimated that at least 65 per cent. of the industry's production is now melted by fuel oil, as opposed to 30 per cent. in 1956.

TABLE 1

Year	*Glass melted million tons*	*Fuel oil consumption thousand tons*
1954	1·475	205
1957	1·750	275
1958	1·920	300
1960	2·290	350

(ii) Gas producer equipment: One of the principal sources of smoke results from the burning out of the producer gas mains. A great deal of research has been undertaken to improve the performance of existing producer plant, to increase the efficiency of combustion in the producer plant, and thereby reduce the amount of tarry deposit in the main. This problem arises mainly from installations with long flues which have been in existence for some years, and can be largely avoided in new installations.

In a paper published by the Institute of Fuel in 1961[2], Buleraig, Allen and Williamson describe the measures taken at a large glass works to reduce the smoke density during burnouts to within the statutory limit.

Further research has been made into the problem of smoke emission which arises during the reversal period of a producer gas fired furnace. It is now possible to effect a reversal without exceeding the statutory limit. Details of a successful modification are contained in a paper published by the Institute of Fuel in February, 1961[3].

A number of problems in this industry remain to be solved; the appreciable cost of new equipment and in some cases the limitation of space give rise to some concern. There has been a close co-operation between firms, and some of the large concerns have not only helped the smaller ones with technical advice but even acted as mediators where difficulties have arisen with the authorities.

(*b*) *The Heavy Clay and Refractories Industries*

In the Heavy Clay and Refractories Industries there has been a general reduction in the consumption of solid fuel due to increase in efficiency of use. This has been effected by making greater use of continuous kilns; increasing the efficiency of intermittent kilns; by making use of waste heat from the kilns for drying; doing away with old inefficient boilers, steam engines and drying sheds, and using electricity for power. The consumption of solid fuel has also been reduced by the extending use of fuel oil. Producer gas for continuous kiln firing has been replaced almost entirely by oil firing.

Smoke emissions occur mainly from the firing of intermittent kilns. It was estimated in 1955 that there were approximately 5,000 intermittent kilns in use firing heavy clay and refractory products. Most of these were coal fired by hand. The trend in the industry is to replace these wherever possible with continuous kilns, on the grounds of increased fuel efficiency and reduction of smoke emissions. The fuel consumption per unit of output of the continuous kiln is only one-quarter to one-half that of the intermittent kiln. This replacement will probably extend over a period of 20 years or more, but some intermittent kilns may still be required for firing specialized products. Consideration is being given to the design and operation of intermittent kilns. Mechanical stoker firing with coal and oil firing are to a certain extent replacing firing with coal by hand. It is estimated that there are 500-600 intermittent kilns fired by these means, of which possibly 300-400 are mechanically coal fired. Each conversion costs approximately £1,000-£2,000.

The capital cost of a continuous boiler one of which replaces five or more intermittent kilns, ranges from £30,000 to over £100,000 according to its size and type. They are being applied to an increasing number of products for instance for firing basic bricks, where continuous car tunnel kilns have largely replaced coal fired intermittent kilns (at a cost of from £600,000 to £1,000,000) for firing salt glazed pipes where continuous chamber kilns are being adopted and for fireclay goods.

The use of fuel oil in place of coal has increased considerably in the last five years. It is estimated that 60 per cent. of basic refractories, 20 per cent. of fireclay and silica refractories, 10 per cent. of salt glazed pipes and 5 per cent. of building bricks are now fired with oil.

The main problems in the industry are the heavy smoke emissions produced during the firing of blue bricks, particularly during the reducing period of the firing and the fume emission during the salting period of the firing of salt glazed pipes, when salt is thrown on the fires in order to produce the glaze. The total coal used for firing blue bricks is only about 100,000 tons per annum, so that although the emissions are a nuisance locally they are not very widespread. Two Working Parties have been set up to deal with the problem involved in the firing of these products.

(*c*) *The Pottery Industry*

In the early thirties, pottery firing was carried out almost entirely in coal fired intermittent kilns. This process was inefficient, the efficiency of firing being 1-2 per cent. Gradually more efficient methods were brought into operation, namely firing in continuous car tunnel kilns. The first of these were fired with producer gas, but later electricity (for decorating kilns) and then town gas were utilized. The progress in the changeover in firing practice is illustrated in Table 2. This shows that in the Stoke-on-Trent area the

TABLE 2

Change in types of kilns and fuel usage, 1927-1959 (Stoke-on-Trent)

	1927	1932	1938	1951-52	1957	1959
Coal fired intermittent kilns						
Number (approx.)			2,000	600-700		200-250
Coal consumption per year (approx.)			1,000,000 tons	400,000 tons		200,000 tons
Continuous car tunnel kilns						
Number fired with:						
(*a*) Town Gas	—	1	61	172	262	275
(*b*) Electricity	1	10	26	93	110	109
(*c*) Fuel Oil	—	—	2	7	20	29
(*d*) Producer Gas	?	?	20	31	8	7
Total	?	?	109	303	400	420
Modern intermittent kilns						
Number fired with:						
(*a*) Town Gas	—	—	—	21+	64	64
(*b*) Electricity	—	—	—	20	277	500

coal consumption has decreased from about 1-1¼ million tons in 1938 to about 200,000 tons in 1959, during which time the number of coal fired intermittent kilns in use decreased from about 2,000 to 200. The present kilns, of the continuous car tunnel type are fired mainly with town gas and electricity, and some fuel oil.

In the last 3-4 years, a large number of modern intermittent kilns built of refractory insulating brick and of the bogie or top hat type, have been built at those factories which are small or had not the capital or space available for a car tunnel kiln. Most of these are heated with electricity but some are fired with town gas.

Because of the lower price at present for fuel oil, about 8d.-10d. per therm in contrast to about 12d.-14d. for town gas and 28d.-38d. for electricity, use of fuel oil is tending to increase for the firing of car tunnel kilns. Some muffle tunnel kilns fired with producer gas have been converted to firing with fuel oil, and new kilns erected for firing sanitary ware are usually fired with fuel oil.

The estimated percentage of biscuit, glost and decorated ware fired by the various fuels in the years 1938 and 1958 are given in Table 3. These again show the decrease in the use of solid fuel. It is expected that in a few years' time coal fired intermittent kilns will only be used where there are special difficulties in firing the product otherwise and that the number in use will be very small. The 200 in use in 1959 are still decreasing in number through replacement by car tunnel or modern intermittent type kiln.

The consumption of town gas and electricity for pottery firing in the Stoke-on-Trent area for the year ended March 31st, 1957, were 6,422,000,000 cu. ft. and 70,930,000 kW hrs.

Thus in the pottery industry the use of raw coal is gradually being eliminated except where needed for boiler firing to produce power or steam for drying the ware, but even here electricity is replacing steam for power.

TABLE 3

Percentage of pottery ware output fired with the different fuels

	Year 1938	*Year* 1958
	%	%
Biscuit Firing		
Coal	90	22
Town Gas	10	54
Electricity	—	10
Fuel Oil	—	14
Glost Firing		
Coal	82	7
Town Gas	18	53
Electricity	—	12
Fuel Oil	—	28
Decorating Firing		
Coal	80	2
Town Gas	5	44
Electricity	15	54
Fuel Oil	—	—

The industry in the future will rely mainly on town gas and electricity for firing, and for firing efficiently. Fuel oil, while it is cheaper, may encroach on the other two fuels where its application is possible, for instance in the firing of muffle kilns.

The cost of conversion has been great but it should be stated that this conversion has been due to economic considerations as well as to the necessity to comply with the Clean Air Act. More efficient firing, better operating conditions for the operatives, better factory layout with straight line flow have resulted. Many factories have been redesigned for the new conditions, so that the total cost often exceeded considerably the cost of the new kilns. The cost of continuous car tunnel kilns varies with their type and size, and range from £6,000 to £100,000 with average range say from £10,000 to £40,000. The new type intermittent kilns on the other hand range in price from £1,000 to £6,000 with average range from £2,000 to £4,000.

Difficulties occur with the old type intermittent kilns coal fired by hand.

Smoke emissions occur at each charge of coal; methods can be adopted to keep the emissions down but not within the limits of the Clean Air Act. Mechanical coal feeding has been tried but not continued with, the best practice being to replace this type of kiln with more modern designs.

(*d*) *The Chemical Industry*

The problems which arise in the chemical industry are associated in the main with processes registrable under the Alkali &c. Works Regulation Act 1906. The annual reports of the Chief Inspectors indicate that the situation regarding emissions of smoke, grit and dust is satisfactory. Where the problem is largely one of smoke elimination, the remedy has been the installation of mechanical firing. Up to the end of 1960, 67 of the 80 open pans which still exist in the salt industry have been fitted with mechanical stokers.

The greater part of the modifications carried out in this industry concerns steam raising plants, and includes substitution of coal by smokeless fuels and the installation of dust arresting equipment.

(*e*) *The Iron and Steel Industry**

The 97th Annual Report on Alkali &c. Works[4] states in a review of the iron and steel industry, that although some problems still prove intractable, by and large the major decisions have been taken. " Industry and the inspectorate are agreed," says the report " on the broad lines of the measures to be taken to deal with the great task in front of us. The cost will be recorded in millions of pounds and man hours; nonetheless there are grounds for sober confidence that the next two years will see remarkable progress. A sound and satisfactory start has already been made."

The iron and steel industry presented the most problems for solution. " In the cold print of a report " says the Chief Inspector for Scotland (Dr. E. A. Balfour Birse), " progress may not seem so impressive as it is in fact. Again the scale on which fume treatment has to be undertaken is not always easy to appreciate and the results may be overshadowed by other discharges of long standing. Fume treatment for an open hearth furnace may be in the order of £100,000. The expensive treatment at smaller furnaces such as are used in the steel foundry industry, will be less but still substantial. The overall cost to the iron and steel industry seems likely to be several million pounds, spread over a period of years. It is greatly to the credit of the industry that this onerous task is being faced with determination and goodwill."

The air pollution problems of the iron and steel industry may be divided into two parts:

1. those common to all users of carbonaceous fuels (in this category the pollution problems are intensively related to fuel efficiency), and
2. those of specific metallurgical application.

(i) Fuel Efficiency: It is sufficient in a short paper to indicate that the use of these fuels in many potentially dirty operations is rapidly decreasing (Table 4) despite increased steel output. The increase in liquid fuels and electricity consumption is shown in Table 5.

This trend has its roots in the drive for increased productivity and efficiency, but it has been accelerated by the rapidly worsening ratio of coal/oil and coal/electricity prices.

Discharge of dust and smoke near ground level is particularly undesirable and in this respect it is interesting to note that coal consumption in locomotives and loco-cranes has decreased by almost 40 per cent. in the last three years. A number of companies have completely replaced their fleets of coal fired locos.

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* Excluding the sections covered by the Joint Iron Council and the British Steel Founders' Association.

TABLE 4

Coal consumption in the iron and steel industry (excluding coke ovens and foundries)

	1954	1957	1960
Steel production ('000 tons)	18,520	21,699	24,305
Coal consumption ('000 tons) in:			
(*a*) locos and loco cranes	497·9	424·6	260·5
(*b*) boilers	1,775·2	1,490·8	1,141·9
(*c*) gas producers	2,850·4	2,427·7	1,733·9
(*d*) furnaces, direct fired	633·9	471·8	264·2
(*e*) other uses (excluding coking)	226·8	179·2	116·7
Total coal consumption ('000 tons)	5,984·2	4,994·1	3,517·2

TABLE 5

Consumption of Electricity and Major Liquid Fuels in the iron and steel industry

	1954	1957	1960
Consumption of:			
Electricity (million kW hrs.)	5,365·4	6,732·1	8,381·0
Tar and Creosote/Pitch ('000 tons)	498·4	922·8	881·3
Fuel Oil ('000 tons)	1,165·5	1,460·6	2,408·8

(ii) Metallurgical Applications: Those processes presenting special technical difficulties in air pollution control (*e.g.* iron making and steel making) were scheduled under the Alkali Act in 1958 and since then the Industry's representatives have had a number of meetings with the Chief Alkali Inspector to decide on the " best practicable means " of dealing with emissions from them and considerable progress has been made in applying them.

Concerning blast furnaces; these were at one time a major source of air pollution, but the increasing demand for clean blast furnace gas as a low grade fuel has meant that almost all the gas produced at integrated works is efficiently de-dusted (to less than 1 lb. of dust per million cubic feet of gas) before combustion and eventual release to atmosphere. It has been agreed that *deliberate* bleeding of excess dirty blast furnace gas, with the furnace full wind, should be discontinued.

Blast furnaces are of necessity fitted with safety valves. A sudden descent of the charge results in the opening of these valves and the release of dirty gas to atmosphere. Slipping of the charge has been very greatly reduced in recent years by prior grading, and preparation of iron ore in sinter machines. In these machines, fine ore is agglomerated by semi-fusion, the product—" sinter " —being a permeable, clinker-like material. The sintering operation is itself a source of air pollution but increased experience of the process has led to the development of satisfactory cleaning plant for dealing with the entrained dust. The de-dusted gas then goes to the atmosphere via a tall chimney.

The most spectacular recent development is undoubtedly the use of oxygen in steelmaking vessels. Air contains 21 per cent. oxygen; the remainder is largely nitrogen which is inert and plays no active part in combustion. If fuel is burned in pure oxygen the rate of reaction is enormously speeded up, an obvious point of attraction for any steel maker. Pure oxygen is prepared from air by cooling and liquefaction, followed by fractional distillation.

The oxygen is used in two distinct ways; firstly to enrich the air used for burning the fuel, and secondly injection via a lance into the bath of molten iron. If the latter application is intensive, iron oxide fume is formed and emitted with the waste gases, giving rise to the easily recognized reddish-brown chimney plume which has appeared in steelmaking districts in the past few years.

The problem of cleaning these gases has been solved in principle, and a number of high efficiency cleaning units are already in use with open hearth and electric arc furnaces and oxygen converters. In the open hearth furnace the waste gases are contained in a flue system into which the cleaning unit is built but in the case of LD and Kaldo converters and electric arc furnaces using oxygen intensively, a containment system must be specially made and so designed that its use must not affect the quality of steel being made. Solutions to all these problems have been found and high efficiency cleaners are being installed but the bottom blown converter, with its variable blowing position, still remains as the ultimate test of the engineer's ingenuity. Fortunately there are very few bottom blown converters in the United Kingdom, and even this number is expected to decrease within the next few years.

A high efficiency cleaning plant for a steelmaking furnace is an elaborate, highly specialized piece of equipment costing, in the case of an electro-precipitator, possibly £70,000.

Additional equipment, *e.g.* waste heat boiler and ducting may be required for cooling the waste gases to a temperature acceptable to the cleaning plant, in which case the above figure may be doubled or even trebled. Thus, waste heat boilers and cleaning plant for a single open hearth shop may cost £1 million or more—an appreciable sum of money by any standards.

It has been agreed with the Chief Alkali Inspector that all furnaces making regular, intensive use of oxygen for refining shall be fitted with fume collecting equipment, although a period of grace is allowed during which experimental work may be permitted under approved conditions.

The adoption of the system whereby processes presenting special technical difficulties are supervised by a central highly qualified inspectorate has been thoroughly vindicated by the progress made. Coupling this with the increased efficiency of operating non-scheduled processes, means that the Industry can fairly claim to have made a more than proportionate contribution to clean air in recent times.

One aspect about which little is said is that of sulphur dioxide. A large part of the sulphur in fuel is normally burned to sulphur dioxide and emitted to atmosphere with the waste gases; no generally applicable solution to this problem has been found, and the best practicable means of reducing sulphur dioxide pollution at ground level is to discharge sulphurous gases high, hot and dry. In this respect again industry is much more effective than the individual householder.

6. Height and Design of New Chimneys

Experience in the first two years of the operation of the Act indicated the need for more general understanding of the principles of chimney design.

The conclusions and recommendations of the expert working party appointed by the Federation were published at the beginning of July. They include recommendations of a general character on chimney design which are applicable to all classes of plant; recommendations for chimney heights for small industrial boiler plants; recommendations on chimneys for large commercial buildings; recommendations for estimating chimney heights required to prevent any sulphur dioxide present in the flue gases from becoming harmful at ground level under ordinary weather conditions; and recommendations on control of grit and dust deposits by relating the height of a chimney to the amounts of grit and dust escaping a dust arrestor.

The recommended height for the chimneys of small industrial plants is based on the boiler capacity, over a range of from 5,000 to 33,000 lbs. per hour, the minimum height being 60 ft. The height increases with the boiler capacity in steps of 20 ft. up to 120 ft. in accordance with a curve having a slope designed to give a theoretically constant low maximum ground-level concentration of SO_2 and rate of dust deposit in the absence of disturbances to air flow.

These recommendations are made subject to the provision that the calculated maximum rate of deposit of grit and dust from the discharge should not exceed 1000 gram/100 sq. metres per month and that the chimney top is not seriously affected by down draughts exerted by neighbouring buildings.

For capacities over 33,000 lbs/hr. the minimum height should be over 120 ft. or 2½ times the height of the adjacent building whichever is the greater. Where it is too costly to apply the "2½ times rule" it is recommended that the height and best location should be determined by wind tunnel tests.

It is further recommended that a review should be made of heights complying with these recommendations after two years or early in 1963.

These recommendations were incorporated in a paper[5] read before the Institute of Fuel and were generally favourably received.

During the course of the working party's investigations, discussions were held with the Department of Scientific and Industrial Research regarding the initiation of a study, in a wind tunnel, of the dispersal of chimney gas from scale models, from the results of which it is hoped to be able to predict the dispersal from actual chimneys.

The Department has now agreed to accept responsibility for a limited programme of work which will be carried out by the National Physical Laboratory in co-operation with the Warren Spring Laboratory. Before any detailed model tests are made, the validity of tests in a wind tunnel will be settled by comparing results from an existing plant with those obtained from a model in a wind tunnel. The existing plant will consist of a portable chimney at the Warren Spring Laboratory which can be moved to different parts of the building and the effects of chimney height, gas temperature and gas velocity on the dispersal of the flue gas will be examined photographically.

Conclusions

Although the information given in the paper does not purport to cover completely the complete range of industry, sufficient is included to demonstrate that industry is answering the challenge of pollution in a vigorous and determined manner. Where the remedies are known they have been applied up to the limits of the means available and where they are not, investigations have been set on foot to determine them. Trade Associations, Research Associations and individual firms have all co-operated in the work.

Expenditure, much of which has not been recovered from reduced costs and additional production, has been high and a great deal more will be needed in the future.

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III. FUEL EFFICIENCY ASPECTS

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Introduction

IN post-war years very considerable improvements have been achieved in the use of fuel in industry. Although these improvements have been mainly developed in the drive for fuel efficiency the adaptation of techniques and plant that promote efficiency are closely allied to the requirements of smokeless combustion, indeed almost every improvement in fuel efficiency is a contribution to cleaner air.

It is four years since the requirements of the Clean Air Act became law and in this paper a few of the industrial aspects are outlined as seen from a view point of fuel efficiency generally, but particularly in relation to the progress being made towards a cleaner atmosphere.

The provisions of the Act relating to industry are fairly well known, the main obligations being that dark smoke must not be produced, grit and dust must be kept to a minimum and any new plant to be installed must be approved or at least notified to the local authority. It is also implied that as technical developments produce better equipment, this must be installed.

Industrial Problems

At the inception of the Act's operation, a large number of industrial firms found it necessary to determine three main technical factors relating to their fuel-using plant.

1. What first-aid treatment was necessary to ensure that the day-to-day operation of boilers and furnaces would conform to the requirements.
2. What techniques and alterations should be adopted to ensure that dark smoke, grit and dust were not emitted.
3. The technical and economic factors involved in making major changes, *e.g.* mechanical stokers, grit and dust arresting equipment, mechanical draught, increasing chimney height and erecting new chimneys.

Boiler Plant Smoke

A very large number of requests were received from industrial firms for *ad hoc* visits, under the Specific Advisory Service operated by N.I.F.E.S. to give advice on smoke and grit problems. In many cases these visits enabled the causes to be quickly pin-pointed and the problems resolved to the satisfaction of the firms and the local authorities. An analysis of these visits showed that the smoke emission from boiler plant was mainly controlled by the following factors:

1. *Design of Plant*—With a hand-fired boiler using bituminous coal, the smoke emission potential was considerable.
2. *Maintenance of Plant*—Repairs and replacements together with a reduction of air intake are frequently the means of effecting improved combustion.
3. *Type of fuel consumed*—Various types of mechanical firing equipment require the correct type and grade of fuel for efficient and smoke-free operation.
4. *Variable boiler load*—In a number of cases of smoke emission, the boilers were operating near or above their rated capacity. Again, lightly loaded units were often prone to smoke emission.
5. *Standard of Operation*—This was probably the most important factor in regard to smoke emis-

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[*] National Industrial Fuel Efficiency Service.

sion. It was found that an untrained fireman or boiler attendant could cause a considerable smoke nuisance even with a well-designed and equipped plant.

With regard to the type of fuel in use, it could not be said that it was unsatisfactory until the possibility of indifferent firing or plant overloading was eliminated.

The National Coal Board gave every consideration in attempting to supply the required type of fuel for the plant.

Good housekeeping and trained boiler operating staff were found to be the two main essentials in controlling the smoke emission from a large number of boiler plants.

In some areas of the country, owing to many reasons, firms had been left with Lancashire boilers far too large for the load they had to carry.

As an alternative to purchasing a smaller boiler, the five pass system of firing through one tube only has been developed and is recommended where the draught is sufficient and the load does not exceed 50 per cent. of the boiler rating. The cost of this conversion, including the underfeed mechanical stoker, is a considerable saving in capital compared with the purchase of a new boiler.

It enables the mechanical stoker to operate at a rating which ensures reliable smoke free combustion.

Surveys

In some cases, smoke and grit problems were encountered where the cause or the cure was not so apparent and here a more detailed technical investigation was carried out by means of a Heat and Power Survey. In all cases a survey of this description resulted in recommendations for the elimination of smoke and grit problems in addition to economies in the use of fuel, and utilisation of steam.

Once such problems were solved, industrial concerns can see that it is only sound sense to ensure that the standard is maintained. Arrangements in many hundreds of cases have been made under a Regular Service Agreement for plants to be visited regularly so that there is no falling off in the efficiency of the plant, or recurrence of smoke and grit problems.

In this country there are 5,600 establishments in general industry, where over 1,000 tons of coal or 500 tons of oil are used per annum. In addition there are 30,000 smaller industrial consumers besides commercial and non-industrial establishments.

At present N.I.F.E.S. have regular contracts with over 5,000 firms and approximately 12,000 visits are made annually to other establishments.

From these figures it is clear that N.I.F.E.S. Engineers have an active day-to-day contact with many of the industrial smoke and grit problems.

To facilitate their work in carrying out surveys it has been necessary to obtain several thousand measuring instruments which represent an investment, at cost, of £165,000.

There are not many industrial firms who can carry an establishment of technicians and instruments adequate for every purpose and the ability to augment both staff and instrumentation for a period of investigation in any of the problems of smoke, grit and dust emission and fuel utilization generally, has been found well worth while.

Grit and Dust Emission

The Clean Air Act resulted in considerable attention being focused on the reduction of grit and dust emission and N.I.F.E.S. have received many enquiries from firms and local authorities regarding information about the most practical means of minimizing this problem without heavy expenditure on new equipment.

Section 5 of the Act requires the use of any practical means of minimizing grit and dust emission from boilers and furnaces. Section 6 goes a stage further and requires that any new plant burning one ton or more of solid fuel per hour, or any pulverized fuel, must be fitted with grit and dust arresting plant approved by the local authority.

Apparatus specially designed by the British Coal Utilization Research Association is now being used by N.I.F.E.S. Engineers as a basis for advice on grit and dust emission problems.

The apparatus is also being used to test the efficiency of grit arrestors and their operation, since the Act requires that these units must be properly maintained and used at all times. Seventeen investigations into grit emission were carried out by N.I.F.E.S. last year.

The cost of grit and dust arresting equipment is considerable and varies with the size and degree of arrestation that is necessary.

It has been estimated that 900,000 tons of grit and dust are emitted annually in this country from industrial chimneys, generating stations, railways and domestic chimneys.

The largest percentage of grit and dust emission comes from all forms of solid fuel burning plant; boiler plant using a small grade of fuel with forced draught and in many types processing furnaces, kilns and cupolas.

Under the Act regulations can be made for recording the measurement of grit and dust emission, but at present, no such regulations have been made.

Equipment manufacturers or industrial users do not have a standard for operation and the existing external methods of ascertaining grit and dust discharge are not reliable in determining the degree of emission.

Unfortunately, the installation of grit and dust arresting equipment does not improve the efficiency of the plant and to the industrialist there is no direct return for the capital outlay and cost of operation and maintenance. In most cases it has been necessary to install induced draught fans when grit arrestors are used; this adds considerably to the initial and operating costs.

The high cost of some of the equipment required has in some instances caused progress to be less rapid than many local authorities would like. There is need for the design of low cost medium efficiency cyclone arrestors which would remove a large percentage of grit and dust without seriously interfering with draught or plant operation.

Training and Education

N.I.F.E.S. provide an extensive programme of education and training. In addition to courses for boiler operators, facilities are provided for students of fuel technology, works and plant engineers and the staff of many government departments, local authorities and the hospital service.

Boiler Operator Training

The time devoted to the training of boiler operators and the encouragement of more men to take the N.I.F.E.S. Course leading to the City and Guilds of London Boiler Operator's Certificate, forms an extensive part of the training programme.

Inexpert operation of boiler plant furnaces is the most frequent cause of smoke emission and it was expected that the advent of the Clean Air Act would result in a considerable increase in the demand for training boiler operators for which N.I.F.E.S. had established a scheme in 1955. Contrary to expectations, enrolments over the past two years were lower than previously.

Last year 483 men enrolled for the Course compared with a yearly average of 1,200 between 1955 and 1958.

Taking into account similar schemes organized by technical colleges, the National Coal Board, the Central Electricity Generating Board, and the Ministry of Health, 8,000 candidates have been successful in obtaining their certificates; of these over one-third of them have been trained by N.I.F.E.S.

Efforts are being made to make the courses better known, but as yet there has been no increase in the numbers coming forward for training.

The number of men employed in boiler houses and furnace operation who have not obtained a certificate is very considerable, probably of the order of 50,000 men. Untrained men are the most likely to contribute to smoke emission and the resultant waste of fuel.

The general experience is that, once the men overcome a natural reluctance to embark on further education, they thoroughly enjoy the course, which combines practical training on site with spare time study at home. The practical training takes place in small groups on the man's own plant, or one nearby, over the 21 weeks' course. More than 80 per cent. of the men trained by N.I.F.E.S. have been successful in obtaining the Boiler Operator's Certificate.

Prior Approval

The provisions of the Act for prior approval of new equipment are of obvious value to the industrialist. They enable him to go ahead with development plans and, provided the plant is properly installed, operated and manufactured, he can be confident there should be no difficulty in regard to keeping below the defined standards of chimney emissions. Applications for prior approval of equipment have to be considered with great care, since the suitability of new equipment depends on factors such as the factory steam load, its variability, the fuel available and the geographical situation of the factory. A number of local authorities employ N.I.F.E.S. to examine applications for prior approval and in some areas adjacent local authorities have formed a joint panel on which N.I.F.E.S. engineers sit to ensure a consistent policy.

In some districts, refresher courses on combustion practice have been arranged for Public Health Inspectors. Elsewhere, assistance has been given to technical colleges in running similar courses. In this way, several hundred Public Health Inspectors have been given a closer insight into the ways in which the organization can assist with the implementation of the Act.

Height of Chimneys

There is no legal standard for the height of chimneys but local authorities have to decide whether plans submitted for new chimneys are satisfactory. The subject of chimney height has been discussed in a number of exceedingly helpful papers, the latest and most comprehensive being by G. Nonhebel to the Institute of Fuel in 1960.

Formulae have been evolved based on most of the prevailing characteristics. However, meteorological conditions, high buildings and the topography of the area in the vicinity of a proposed chimney can change the behaviour of the chimney discharge.

In considering applications for new chimneys, most local authorities determine the height needed to supply the required draught to obtain satisfactory combustion, and take into consideration the surrounding buildings and area so that the chimney emissions do not cause a nuisance.

The higher the chimney, the better the disposal and diffusion of the effluent gases, particularly with reference to sulphur dioxide, but it must be realized that chimney erection is a very costly proposition.

With modern plant and mechanical draught, a chimney is only required to remove the production of combustion. However, if all industrial chimneys were low, the emanations would have a very deleterious effect. Consequently, industrial chimneys must be of such a height that (*a*) the discharge does not cause a nuisance in the immediate vicinity and (*b*) the effluent should pass into a strata where disposal is rapid and complete.

No detailed technical advice has been issued from any Government Department. Consequently, local authorities, chimney design engineers, industrialists and N.I.F.E.S. have to consider all the factors and be satisfied that any proposed chimney height will be sufficient to prevent the products of combustion from causing a nuisance, as far as practicable.

The main bases used by most authorities for deciding chimney heights are:

(*a*) plant served by the chimney, draught required, amount of fuel used, quantity of deleterious gases;

(*b*) height and proximity of nearby buildings;

(*c*) topography of area;

(*d*) all other factors.

As far as can be determined, over 3,000 plans have been submitted to local authorities for new chimneys. 68·5 per cent. were approved without amendment, 29·5 per cent. approved after amendment whilst only 2 per cent. had been refused approval.

New Stokers' Manual

In 1959 N.I.F.E.S. prepared and published a new booklet on the operation of boilers and central heating plant. This was a complete revision of the manual previously published for the Fuel Efficiency Committee of the Ministry of Fuel and Power.

The booklet covers developments in the mechanical firing of Shell boilers with coal, and includes a new section on oil firing.

Special attention is given to the provisions of the Clean Air Act and the prevention of dark smoke. This booklet is intended as an introduction to the Course for the Boiler Operators' Certificate and the presentation is as simple as possible with a practical emphasis throughout.

Nearly 21,000 copies have been sold and it is clearly being used by thousands of men, including many who have already obtained their certificates, to refresh their memory and assist them in their day-to-day work. It is considered that this manual is playing a useful part in the campaign for Clean Air.

Mechanical Firing

There is a general trend in industry to convert boilers from hand to mechanical firing and it has been estimated that there are many thousands of hand-fired units which will eventually require converting. Experience by N.I.F.E.S. has shown that although conversion is initially a costly project, a higher overall efficiency is obtained by mechanical firing as compared with hand-fired practice.

In recent years, considerable improvements and amendments have been made in mechanical stokers; in many cases specifically to enable the fuel burning operation to comply with the requirements of the Clean Air Act. Such amendments as being able to operate mechanical stokers at separate speeds and fuel feeds on individual furnaces of Lancashire Boilers, the provision of secondary air to underfeed stoker fired furnaces in vertical boilers and the extended running of the fan when the coal feed screw is stopped, have been some of the measures adopted to control smoke emission.

However, to convert all hand fired furnaces to mechanically fired units will cost many millions of pounds and it is this initial cost that is limiting the rate at which mechanically fired stokers are installed.

Conclusion

The Clean Air Act will not solve the problem of air pollution overnight. A good beginning has been made and it is with pleasure and pride that those responsible can look across large industrial towns from a high level and see the visual improvement particularly in the smoke control areas.

The Department of Scientific and Industrial Research (Atmospheric Pollution Research Department) have summarized from the collected measurements of atmospheric pollution records throughout the country that there has been a steady decrease in smoke pollution since 1956.

How can further progress be accelerated in the industrial field:

1. Stoking should be recognized as an operation requiring skill and firemen should be properly trained, certificated and remunerated.

   The proposed Bill for the

Certification of Furnace Operators is due for discussion at this Conference.

The standard of skill required from the individual operator is fully recognized by large fuel users such as the Electricity Authorities, and is reflected in the thermal efficiency improvements recorded in successive annual reports. An equally high standard is called for from the personnel engaged in boiler operation in general industry.

2. As many industrial smoke problems depend for their solution more on the intelligent application of existing knowledge than on starting new researches, there is need for active co-operation between industry and their trade organizations able to carry out detailed surveys of the problems involved. In the great diversity of industry and manufacturing processes, each of a hundred trades has its own special furnaces in which fuel in some form is used. In contrast to steam-raising, where the problems and solutions are known in the half-a-dozen main types which supply most of the needs, process furnaces require specialized treatment which is highly technical and demand skill and knowledge which can only be supplied by the rational and economic co-operation of all concerned.

3. Uniformity of administration is not universal throughout the country; in the large industrial towns and areas industrial smoke control is administered fully by the provisions of the Clean Air Act, but in other areas improvement is limited. The reviews made by the Clean Air Council in regard to atmospheric pollution should be known to everyone, and publicity by every known medium is essential to implement the aim of clean air. The rate of progress will depend in part on technical and economic factors, and on the interest of everyone concerned, including the general public.

IV. BOILER PLANT DESIGN AND EQUIPMENT

By

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General

THERE can be little doubt that the owners and managers of industrial boiler plant are becoming increasingly aware of the necessity of complying with the requirements of the Act, even if a detailed appreciation of its provisions and of the steps which can be taken to meet them is often rather lacking.

Fortunately, as knowledge spreads in this respect, it can be said that there is no real difficulty in complying with the Act as regards boiler plant—the case is often different with small metallurgical furnaces, for instance, where the process requirements can be more difficult to carry on with reasonable freedom from atmospheric pollution. There is no reason why a boiler plant should emit smoke, grits or acid smuts to the annoyance of the community while, although the emission of SO_2 cannot be eliminated, adequate dispersal can be achieved. There may, of course, be individual instances where site limitations add greatly to the difficulties.

The range of industrial boiler plant considered in this Paper will be roughly that of installations comprising one to four or five boilers, with total outputs ranging from about 10,000 lb. of steam per hour to, say, 60,000 lb. per hour and, in general, shell boilers of one type or another will be in mind.

Atmospheric Pollution

As far as concerns boiler plant this may be considered under three main headings:

(1) *Smoke Emission*

With modern combustion equipment, using either coal or oil, boiler firing need not, and therefore should not, produce any perceptible smoke. If it is produced it cannot be eliminated from the flue gases.

(2) *Emission of Solids*

(*a*) Grit emission is a problem only of coal firing and this is not a matter which, as in the case of smoke, can be eliminated at source. The increasing proportion of fine particles in washed smalls, due to increasing mechanization of coal-cutting and coal-conveying at the mines, makes it almost certain that there will be some carry-over, and perhaps a considerable carry-over, of grits from the stoker into the boiler system. Even with what used to be considered a reasonable proportion of fines " through $\frac{1}{8}$ " there is likely to be more carry-over than formerly, as the proportion of very fine particles increases. Though grit production, to a greater or lesser extent, is inevitable, there is no real problem about removing grits from the flue gases before emission to the atmosphere.

(*b*) Acid smut emission may be considered to be the potential trouble with oil firing, equivalent to grit emission with solid fuel. These smuts are not formed in the course of combustion in the furnace, but result from undue cooling of the chimney gases, when condensation causes sulphur-laden soot particles to attack the steel of the chimney, forming black smuts which are then ejected by the higher gas velocities of the next high load period. The cure for this is in the field of chimney design.

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(3) *SO_2 and Fine Dust Emission*

Fine dust, which cannot effectively be removed from the flue gases, can be classed with the sulphur products of combustion as being only capable of being dealt with by adequate dispersion from the chimney, as there is at present no effective system for removing sulphur products from the flue gases of industrial boiler plants. Oil firing, while free from grit or dust production, involves a high sulphur discharge, partly because of the higher sulphur content of fuel oil and partly because with coal firing a considerable proportion of the sulphur is absorbed in the ash.

It may be noted that while limits may be specified for smoke, grits, fine dust and SO_2 emission, any question of acid smut emission can at present only be dealt with as a " nuisance " in more general terms.

New Installations

If a new boiler plant is being planned, the main points to be considered in relation to the Act are as follows:

Combustion Equipment

This will consist either of mechanical stokers for solid fuel or burner assemblies for oil fuel. In both cases there is considerable choice of types—chain-grate stokers, coking stokers, sprinkler stokers or underfeed screw stokers for coal and pressure-jet, steam-atomizing, high-, medium- or low-pressure air atomizing or rotary cup burners for oil. All these types, suitably installed and operated with reasonable care and intelligence, will give smokeless combustion with any grade of solid or liquid fuel which is generally available and it does not seem necessary to consider in detail the various pros and cons of each type and design, especially as these will be affected by the nature of the service required, *e.g.* steady or fluctuating loads. It is clearly important in all cases that the supply of combustion air is entirely and at all times adequate to the supply of fuel—indeed the oxygen of the air is as much the fuel as the carbon and hydrogen of the coal or oil. Much smoke production is caused by trying to throw into the furnace more coal (less often, more oil) than can be burnt by the air supply.

Automatic Combustion Control

This is by now almost standard on oil-fired boiler plants, whether of the simplest " on/off " type, of fully-modulating type, or of the intermediate " high/low/off " system—all normally controlled directly from the boiler steam pressure. With none of these systems is there any reason to fear that the operation of the control will cause smoke.

Systems which may result in the burner operating at low flame for any length of time during periods of low load, may result in the final gas temperature from the boiler being so low that when further cooled in an unlined steel stack the dew-point is reached, condensation occurs and acid smuts are formed. These, of course, cause severe chimney corrosion but this, though in fact a serious matter, is not relevant to the subject of this Paper—not so the resultant later ejection of the smuts so formed. The solution which at present seems to deal with this trouble is to clothe the chimney externally with an outer skin of aluminium sheet metal, providing an insulating air gap which serves to keep the gases above the dew-point.

Automatic variation of coal and air feed in response to pressure variation is not quite so simple, as there is always a mass of coal in the furnace so that while rate of air supply and rate of fuel feed can be controlled as well as with oil, the actual rate of combustion is not so controllable. A period of heavy load may result in a lot of coal in the furnace and when the load goes off and air supply is cut down in proportion to the reduced rate of coal feed to the furnace, the air flow may temporarily be insufficient to burn off the coal without smoke. In one such case recently of an Economic boiler fired with a forced-draught underfeed screw stoker with the induced-draught fan controlled to maintain constant draught in the combustion chamber, this trouble was cured by setting the latter control to provide sufficient draught to burn the coal smokelessly when the steam pressure control had stopped stoker feed and forced draught, a control damper on the forced draught being set to reduce, in operation, the output of this fan to maintain good CO_2.

Automatic Draught Control

This can be a useful and comparatively inexpensive addition to a boiler plant which is not fitted with complete automatic control of combustion. It can be arranged to control the induced draught fan damper to maintain, in the downtake or combustion chamber, just sufficient draught at all loads to pull the gases from the furnace through the tube-passes of Economic boilers or the flues, economizer, etc., of a Lancashire boiler. Not only does this avoid loss of efficiency due to too much air being drawn through the furnace, but grit carry-over will be minimized.

Grit Arresting

As is well known, the Act calls for grit arresters, approved by the local authority, to be fitted to all furnaces burning more than one ton of coal per hour, but there is no definition of a grit arrester. In fact, one of the most efficient principles for getting grits out of flue gases is plain settling out of a low-velocity gas stream and this is provided by the flues of an ordinary Lancashire boiler-plus-economizer installation which will usually provide as efficient a grit arrester as is required—unless, indeed, flueing-out is deferred so long that the flues fill up to the point where the resultant gas speed carries the grit on to the stack. This however, ought never to occur on account of the resultant loss of efficiency and waste of fuel, quite apart from the grit problem. In a number of Lancashire boiler plants which have now been working for years, burning washed smalls on chain-grate stokers, the author has planned the induced draught fans, in capacity and in lay-out, to allow grit arresters to be installed later if proved necessary, but without putting them in. Although some of these plants are in built-up areas, no complaint has yet been made of any grit emission, even though the chimneys are of no great height—about 90 ft. Had grit arresters been installed, it is extremely doubtful if much grit would ever have reached them.

Most new boiler plants today, however, comprise boilers of the Economic type in one or another of the developed designs, and for such boilers grit arresters must be considered essential for coal-fired plant. An interesting table showing the extent of grit extraction with different types of arresters is given by Nonhebel (Journal—Institute of Fuel—October, 1960), which includes the following figures:

Type of Arrester	*Dust Emission as percentage of inlet*	*Tons of dust deposited per year in circle of 500 yards radius*	*Reduction in darkness of plume at chimney mouth per cent*
None	100	120	Nil
Scroll Collector . .	29	1·8	19
High-throughput Cyclone	19	0·9	38
High-efficiency Cyclone . .	9	0·6	60
Multi-Cyclone . .	7	0·3	65

From this it will be seen that while the scroll collector removes only 70 per cent. by weight of the total dust, the fine dust left in the gases can be very largely dealt with by dispersion, the dust deposit figures indicating a very high degree of " diminishing return ". It is interesting to note that removal of further quite small weights of fine dust has a marked effect on the appearance of the plume.

It is probable that the scroll collector is efficient enough for most industrial boiler plants, but further increase in the fuel content of really fine particles may possibly strengthen the case for more efficient, but more expensive, designs.

Acid Smuts

As already mentioned, these occur due to overcooling of the gases from oil-fired boilers in steel chimneys, and insulating the stack by aluminium cladding seems to be satisfactory. This, however, has chiefly been done on quite short steel chimneys of the order of 40-50 ft. in height. If taller chimneys are to be required in future (a point dealt with later in this Paper), it is possible that further steps may have to be taken. If, for instance, a chimney is built 150 ft. high to serve, say, four boilers and if for long periods in the summer when no space heating is required only one boiler is on the line and working for hours at low flame with low gas temperature, there is going to be a very low gas speed up the tall chimney and the small gas volume, taking so long to rise, may still lose heat at a rate which will bring it below the dew-point.

One suggestion to avoid the formation of smuts is to retain single " on/off " control, so that when alight at all, the burners are on full output, arranging that a gas-tight damper should close when the burners shut down, to retain heat in the boiler. This would avoid low gas temperatures in operation, but the gas remaining in the stack would presumably cool down below the dew-point. Indeed, if fuel efficiency were not to be considered, perhaps the best plan would be to have " on/off " control and when " off " let the chimney draw air through the boiler where it would be heated so that it would " dry-out " any solid combustion products in the chimney. This, however, would be a rather wasteful solution and one of the advantages of either " high/low " or fully modulating control is that much of the steam can be generated at reduced rates of firing with consequent gain in thermal efficiency.

Instrumentation

Unless complete reliance is placed on automatic combustion control, adequate instrumentation, suitable for the class and size of the installation, is essential. Moreover, if the automatically-controlled plant is not instrumented it must be very difficult for anyone to ascertain how efficiently the plant is running under the control. Only with the aid of instruments can a boiler be operated at high efficiency and smokelessly. Any industrial boiler plant, except for quite small single-boiler installations, should have the following instruments:

1. *Draught Gauges*—The number and location of these will depend upon the type of boiler plant, *e.g.* self-contained Economic boilers or Lancashire boilers with economizer.

2. *Steam Flow Meter*—This is especially important if firing rate and boiler output are manually controlled since only this can tell the operator what is being demanded of the boiler plant. The indicator of the meter should be on a bold easily-read scale. For larger plants, in addition to the meter on the boilerhouse outgoing main, it is an advantage to have one for each boiler so that the load can be equally shared—or perhaps one or two boilers can be worked as base-load units at high efficiency, and load variations taken on the others.

3. *Temperature Indicator*—Thermocouples at suitable points for gas temperature, feedwater temperature and (for superheated steam) steam temperature can be connected to a multi-point indicator. Recorded tem-

perature instruments are not generally necessary.

4. *Gas Analysis*—This is perhaps the most important unit for effective combustion control. It can measure either the CO_2 content or the O_2 content of the boiler gases and there are some advantages in O_2 measurement as the indication of excess air is less affected by any variation in the nature of the fuel used. It is highly desirable that the analysis cabinet should be as near the sampling point as possible, to give a short gas line. This gives quicker response to changes in combustion condition and there is less risk of condensation, blocking and corrosion of the gas line.

The chief trouble with this essential instrument is that it requires more, and more regular maintenance than any other instrument on the boilerhouse panel. If this maintenance is neglected the instrument will give faulty and unreliable readings (most others are either reasonably correct or obviously not working) and the operator then naturally tends to lose all confidence in it.

Gas analysis is in one way particularly important for oil-fired plants, quite apart from the fact that sustained high efficiency is more valuable when burning an expensive fuel. If, to be sure, and over-sure, of avoiding smoke, far too much excess air is used, the surplus of oxygen will oxidize more of the SO_2 to SO_3, to form sulphuric acid with any water of condensation.

5. *Smoke Detection*—These instruments all work on the principle of a beam of light across the gas duct or flue, falling on a photo-electric cell. Smoke obscures the beam and the resulting effect is indicated by the instrument. This may be a simple alarm—with the bell and lights—it may have a dial with a pointer moving over a scale graduated to the Ringelmann chart or it may also have a recording chart, the latter clearly being the most satisfactory system. For a multi-boiler plant it might well be sufficient to have a recording instrument for the final discharge to the stack with an alarm on each boiler duct. If dirt obscures the protecting glasses of the instrument it may give a false alarm, but this is " failure to safety ", and in general these instruments are very reliable.

Chimneys

As already stated, atmospheric pollution in the form of SO_2 and fine dust particles is inevitable and it must be left to chimney design to effect sufficient dispersion. Various formulae are available for calculating the maximum ground-level concentration of SO_2 and fine dust, but most of them require more accurate knowledge of future wind velocities, etc., than are likely to be available to the designer—he can seldom be very sure that the operating conditions for which he is asked to design the plant will, in fact, obtain in practice. Works' extensions, for instance, unforeseen at the outset, may proceed at the same time as the installation of the boiler plant so that the latter is no sooner completed than it has to be extended.

A committee of the Federation of British Industries, under the chairmanship of Mr. G. Nonhebel, has been considering emission problems and chimney height for industrial plants and has tentatively suggested the following range in the Institute of Fuel paper already quoted:

M.C.R. of boiler plant lb/hr. steam	*Minimum Chimney Height–ft.*
Up to 5,000	60
5,100 to 12,000	80
12,100 to 21,000	100
21,100 to 33,000	120
Over 33,000	120 ft. or 2½ times height of adjacent building, whichever is the greater.

It is suggested that the effluent gas velocity at full load should be at least 25 ft. per sec. if induced draught fans are installed (20 ft. per sec. if forced draught only) and that the heights in the table should be increased by 5—10 ft. if gas velocity is less than

20 ft. per sec. to avoid downwash from the chimney mouth.

The "$2\frac{1}{2}$ times rule" is in some ways rather unsatisfactory. A large boiler plant serving a factory of low single-storey construction would then have a 120 ft. chimney which might give inadequate dispersion of SO_2 and dust, while, on the other hand, a single comparatively high building near the boiler house might enforce a higher stack for a smaller plant. The $2\frac{1}{2}$-times really only applies to a chimney more or less in the middle of a long building.

It may be noted that extrapolation of the table would give a height of 145 ft. for an output range of 33,100 to 45,000 lb. per hour and 170 ft. for 45,100 to 60,000 lb. per hour, and though these may seem on the high side for practical effect, some such development might be sounder than reliance on the $2\frac{1}{2}$ times rule.

One thing seems quite clear, and that is that the recent trend towards installing a row of boilers, each discharging to a short steel stack, must be reversed. Not only must height be increased—and a tall stack to each boiler is clearly a most expensive arrangement—but even then dispersion will be far better if all gases are discharged from one chimney as the much more massive plume will keep its heat much longer and the resulting thermal buoyancy will be equivalent to a taller chimney.

It would seem, too, that these conditions favour a greater return to the brick chimney. The inherent resistance to corrosion and inherent insulation of brick construction, (the latter reinforced by the air-gap between the inner firebrick lining 25—30 ft. high and the chimney shell itself), all make such a stack more efficient in many ways than a steel chimney of equal height and internal diameter.

Some local authorities have specified, or are considering specifying, limits for ground level concentration of SO_2 which seem likely to involve undue exaggeration of chimney height. In some cases the Sutton formula is to be used with an assumed value for wind velocity, but with no allowance for either velocity rise or thermal rise of the gas plume.

In fact, the calculation gives the height from which the SO_2 begins to descend and the chimney has then to be built in brick or steel to this height though really the height would be attained partly by chimney construction and partly by the subsequent rise of the plume.

A further point worth consideration is that this calculation, based on the sulphur content assumes that, both for coal and oil, all the sulphur is emitted and while this is true for oil, some of the sulphur in the coal will be taken up by the ash, so that there is less than 100 per cent. emission.

Existing Installations

For the purposes of this Conference, this section applies only to existing installations which are causing trouble by one or more forms of atmospheric pollution, and in this Paper on the design of plant it is irrelevant to consider plants where these troubles are being caused solely by careless or incompetent operation of equipment which could be trouble-free.

It is not easy to generalize usefully about problems which are essentially those particularly appertaining to individual installations, but some notes may be helpful.

Smoke Emission

Smoke from oil-fired boiler plants is comparatively rare, partly because most of them are of recent date and modern design, partly because, being of modern design, air and fuel controls are linked (so that it is difficult to force into the furnace a fuel supply in excess of the air supply) and probably automatically controlled and partly, perhaps, because if an oil-fired boiler does smoke the volume of rich, greasy, really black smoke that rolls out of the chimney makes it clear to everyone, including the offender, that this must be stopped.

Smoke from coal-fired boilers, basically due to too much fuel for the air supply, may have one or more of several secondary factors:

(*a*) Insufficient draught, usually only natural chimney draught. Remedy—install induced-draught fans (for Lancashire boilers an economizer should also be installed, not only for fuel economy but to prevent excessive gas temperature in the fan). In some cases the provision of forced-draught equipment may assist sufficiently the induced draught, but it is not usually easy to fit forced draught to stokers intended to work on natural draught.

(*b*) Obsolete stokers, without forced draught and, again, with insufficient induced draught. Remedy—new stokers with forced draught and, if necessary, induced draught, as above.

(*c*) Chronic overloading of boilers, with excessive coal feed in an attempt to keep steam pressure. In effect, too much coal rather than too little air. Remedy—more boiler capacity if overloading is long sustained; if it is a peak-load problem, the installation of a steam accumulator, though not a cheap job, may not only solve the overload problem but, since it is no longer necessary to keep on altering fuel and air supplies, the resulting gain in boiler efficiency may give an adequate return on the capital involved. If the overloading, though chronic, is not excessive, an efficient high-duty economizer and proper induced-draught equipment (with Lancashire and ordinary two-pass Economic boilers) may put the plant on top of its job again and will certainly save fuel.

(*d*) Operator's lack of knowledge, *i.e.* not personal ignorance, but having nothing more than pressure gauge and water gauge to tell him anything. Remedy—equip the plant with instruments suitable to the type and size of the installation—and maintain them properly.

(*e*) Leaky settings. Though less prevalent than formerly, there are still many Lancashire boiler plants where the brickwork, though fundamentally far from collapse, has been neglected so that air infiltration is altogether excessive. Especially, of course, if the stokers work solely on induced draught, this is liable to result in smoke as speeding-up the induced-draught fan, if possible, may well pull in so much extra air through economizer setting, main flue, boiler setting (and through standing boilers with ill-fitting dampers) that the fan chokes itself with this air and can produce no more draught in the furnace. Remedy—point up cracks, paint all exposed brickwork to seal it, fit boiler expansion joints at front and back of boilers, take such steps as are practicable to isolate standing boilers, etc. The resultant fuel economy should pay well for all this.

(*f*) *Unsuitable fuel.* With more technical advice from suppliers this is probably less likely than in the past but, especially in small-flued boilers (Lancashire boilers of 8 ft. dia. and less, or equivalent small Economic boilers) there is sometimes trouble with coal of too high a volatile content, giving a long flame for which there is insufficient combustion space between the top of the fuel bed and the crown of the furnace flue. The chain-grate stoker, with its grate surface 3 in. or 4 in. above that of other designs will, in such boilers, leave very little space over the fire. Remedy—change to a coal which will give a shorter flame.

Grit Emission

Unless this is caused by allowing the flues of Lancashire boiler plants to fill up almost solid with grit carry-over, in which case the remedy is obvious, there is not much that can be done except to fit grit arresting plant of suitable type, which will usually involve new induced-draught equipment. Where space is very limited, a grit-arresting fan will take up less room than a separate grit arrester and induced-draught fan, though it may be rather less efficient in grit extraction and will certainly absorb more power. In some cases, usually quite small plants and where there is a sufficient margin of draught available, simple grit arresters for fitting to a steel chimney may be the solution.

The one possibility of curing grit emission without installing new equipment is that of changing the fuel supply to a suitable graded fuel, comparatively free from fines, which is now more practicable than for some time past. Caution must be taken that too good a quality does not cause trouble with burning the stoker grate, due to insufficient ash content to protect the metal.

Acid Smuts

As already indicated, this trouble must be tackled by seeing that the gas temperature in the stack never falls below the dew-point, either by insulating a steel chimney or by some form of combustion control which will ensure a reasonably high gas temperature at boiler exit during combustion periods.

SO_2 and Fine Dust Emission

As will be realized from what has already been said, dispersion is the only practicable cure for this type of emission and, if it is proved that a boiler plant is causing trouble in this way, there is in general no easy solution as an alternative to replacing an existing chimney by a more adequate one. It may well be that the trouble is largely due to the installation of a new and larger boiler plant to work to an existing stack. The modern plant will discharge its gases at a much lower temperature than the less efficient plant it has replaced, while the gas volume, and hence velocity, may not be greatly increased. The more efficient plant may easily produce 30 per cent. less weight of gas per lb. of steam and, at the lower temperature, the volume, again per lb. of steam, will be further reduced. It may well be that 50 per cent. more steam is being produced for the same gas volume and clearly a chimney, previously adequate in height, may now be insufficient, especially as a modern coal-fired plant burning washed smalls with a high fines content may well have a much higher fine dust content in the gases, even after grit arresters, while if oil-firing has been adopted, the SO_2 content of the gases will have increased very considerably.

The condition, therefore, of a new boiler installation to be coupled to an existing stack calls for careful scrutiny of all the relevant factors.

In cases where an existing chimney, steel or brick, is of such a diameter that it is now too large for its duty, so that the gas effluent velocity is too low and there is downwash and loss of velocity rise, it would seem possible to fit inside the chimney top a " nozzle " of cast-iron construction, to increase the effluent velocity with little more loss of draught than is needed to accelerate the gases. With either coal- or oil-firing, if the SO_2 content of the flue gases, considered in relation to ground-level concentration, is too high, the only method of reducing this is to change to a fuel with a lower sulphur content which may be practicable with coal and would certainly be practicable, though not very economic, with oil by changing to a lighter grade.

It may be of interest to note that pulverized fuel firing, commonly thought to be the most likely to cause trouble with emission of all kinds, can, if the whole plant is properly designed, give the " purest " gas discharge from the stack. There is no difficulty in dealing with the fly-ash, though it may not be a very cheap matter, while no other system can give such a low SO_2 content to the gases. This is because of the sulphur-absorption capacity of the ash in the coal—as all this ash goes forward into the gas-stream before being removed therefrom and as, being so finely divided, it presents to the gas an enormous surface area, it can remove a great deal of the SO_2 and, indeed, this seems the only method of firing in which such a reduction can be attained.

Conclusions

In general, it can be said that smoke emission is quite unnecessary since it can, and should, be eliminated at source. There is, fortunately, little difficulty in locating the offending plant.

Grit emission is less easy to prove if there are several boiler chimneys in the vicinity, any one of which may be the offender. In such cases tests can be made on the actual grit content of the flue gases to determine if any particular plant is emitting grits from its stack, though this sort of testing seldom gives results quite as clear-cut as visual inspection of a smoking chimney.

The emission of SO_2 and really fine dust seems likely to be very difficult to bring home to any particular chimney, especially in built-up areas where SO_2 from domestic fires may confuse matters, unless the chimney is so low that sulphur fumes are readily detectable in the vicinity.

Discussion

A. Wade (City of Nottingham) in opening the discussion referred to the progress which had been made from the several points of view, namely, local authority, manufacturer, fuel technologist and plant designer.

Experience of the Act had proved that the abatement of much industrial smoke could readily be achieved. The problem of grit and dust emissions, particularly from plant burning pulverized fuel and from the metallurgical and cement industries, had not been solved.

For some years up to the end of 1957, measurements of pollution in Nottingham had shown progressive reductions but since that year we had recorded increases in spite of the establishment of smoke control areas and the installation of much new boiler plant.

This disappointing experience had been due to a large plant using pulverized fuel where the dust-arresting apparatus had an efficiency of no more than 97 per cent., and from which ten tons of fly-ash escaped through the seven chimneys every twenty-four hours. If the solution of the problem was known the industry would have lost no time in implementing it.

Costly and intensive research was going on but progress had been slow. It was hoped that an answer would be found in the not too distant future but in this connection attention was drawn to the Annual Report on: " Alkali, etc., Works for 1960 " which referred to the problem of grit arrestment in power stations and which stated that " despite intensive study a complete and general remedy is not yet in sight."

From a public health point of view the question arose as to whether in the circumstances described, coal is the best fuel available.

S. Cayton (West Bromwich) said he thought Mr. Dickie was right in thinking that local authorities should generally accept responsibility for industrial and commercial waste disposal. He thought that a multitude of small incinerators discharging at low level was to be avoided. Much of the waste was paper and this should be kept separate to conserve tipping space and allow any clean paper to be returned and sold.

He also asked Mr. Batey if he considered the wet-type of grit arrester fitted to cold-blast cupolas constituted the " best practicable means " of grit and dust suppression at present available for this purpose.

P. Draper (Shell-Mex and B.P. Ltd.) thought the survey by Mr. Dickie was, as might be expected, both comprehensive and informative. The only comments he would like to offer concerned the FBI Handbook on " Height and Design of New Chimneys " as he was unfortunately unable to agree with the conclusions and recommendations of the working party appointed by the Federation and he hoped they might find it possible at some time to issue a revised edition.

His reasons for this statement were briefly as follows:

The recommended height for chimneys of small industrial plants were in his opinion, too high to be economically reasonable and unnecessarily high from the point of view of dispersal of flue gases. Furthermore, the heights were not even justified by the statements and suggestions in the rest of the FBI Handbook.

Mr. Draper pointed out that reference was made in connection with larger boilers to a minimum chimney height of 120 ft. or 2½ times the height of the adjacent building, whichever was the greater and he could not see any justification for either of these stipulations, nor could he see any justification having been put forward in the Handbook.

He continued that Mr. Dickie referred to recommendations incorporated in the paper read before the Institute of Fuel and Mr. Draper did not know if other people interested in this subject had attempted to work out chimney heights from the recommendations, but he personally found it rather disturbing, that at reasonable flue gas exit temperatures of about 300°F. chimneys of any boiler plant of whatever size work out at under 50 ft. in height. Furthermore, if heights are calculated for higher flue gas temperatures of 600°F. negative chimney heights can be obtained. He had referred to these anomalies in discussion on the Institute of Fuel paper and was distressed to find that the FBI Handbook still offered these possibilities which might be seized upon by boiler plant operators who were interested in spending very little money on their chimneys, although he did not think that chimneys of negative height would prove to be a real economy!

Mr. Draper wished to ask one question concerning Mr. Opie's statement which read as follows:

"As far as can be determined, over 3,000 plans have been submitted to local authorities for new chimneys: 68·5 per cent. were approved without amendment, 29·5 per cent. approved after amendment, whilst only 2 per cent. had been refused approval."

He would like to know what had happened to the 60 chimneys thus vetoed.

Mr. Draper contributed to Mr. Webber's notes concerning the elimination of acid smuts from oil-fired boiler plant. Mr. Webber had mentioned the now well known means of curing smuts from steel chimney stacks by keeping the inner metal surfaces above a critical temperature and he thought that this might be difficult with high chimneys, for instance of 150 ft. Mr. Draper assured him that the cure effected by shielding the steel stack with an aluminium outer skin could be quite satisfactory even with tall chimneys and that that had been achieved in many cases.

Mr. Draper added that the difficulty of keeping steel or brick chimney surfaces hot when several boilers were connected to the same chimney and all may not be firing at the same time, could be overcome by either of two methods, both of which incidentally, were shown diagrammatically upon the exhibition stand of his Company (Shell-Mex and B.P. Ltd.). One method would be to provide individual flues for each boiler all the way from the boiler to the top of the chimney, thus any one flue could be kept at a high temperature without fear of it being chilled by cold air from the off-load boilers. This was not considered to be as expensive as it might appear at first sight, but in general would be more applicable to new plants than to existing. In the case of existing plant, it would perhaps be easier to fit 100 per cent. closing dampers to each boiler, so that no air leak could occur from off-load boilers and then to fit a restrictor at the top of the chimney, so that the gas exit velocity would be high enough to prevent recirculation of cold air down from the top of the chimney as sometimes happened in practice.

He would endorse Mr. Webber's suggestion that the best method of disposing of sulphur oxides from any combustion equipment was to disperse them harmlessly into the atmosphere and he suggested that this was generally the case from all satisfactory chimneys and that the number of offenders in this direction was probably extremely small compared with the total number of chimneys involved.

T. H. Iddison (Dartford) said that the Chairman had stated that the position in the industrial field would appear to be one of cheerful optimism and Mr. Dickie had stated that there was no industrial pollution problem that could not be solved provided there was the will to solve it. Mr. Iddison could state quite categorically that the position on the Thames-side was far from one of cheerful optimism. None of the speakers had made any mention of dust from cement works. He did not find this surprising as probably not more than half a dozen of the 300 to 400 local authorities represented had cement works in their areas, but the problem was a serious one and in order that the Conference might have some idea of its magnitude he would remind them that both the President and Mr. Opie had quoted a figure of 900,000 tons of dust emitted annually in this country from all sources. The Chief Alkali Inspector had quoted figures from which it could be deduced that 22,500 tons of dust were emitted annually from six factories in a small area on Thames-side. If the former figure was an accurate one then the amount of emission from these six factories was the equivalent of 2½ per cent. of the estimated total emission from all sources in the country. Did Mr Dickie consider that this was a problem which required only the will to solve it or, if not, what was the solution.

P. H. G. Grimmett (Wednesfield)

agreed that there was a sense of optimism about the whole position of clean air associated with industry, particularly in the papers that had been read before the Conference. He expressed concern, however, that such industrial co-operation had been relative to the reduction of atmospheric pollution from the source of fuel burning and the creation of smoke, *i.e.* where there was a financial return, and was of the opinion that such co-operation had not been apparent where fume emissions were concerned, and referring to ferric oxide emission from steel converters of the tropena type he instanced the knowledge of a plant effectively controlling this type of fume more than three years ago, yet no particular steps had been taken to implement such experience gained.

Mr. Grimmett expressed concern at the Government attitude in this particular respect having regard to the circular recently received reminding local authorities that industry must conform to the Clean Air Act by 1963 and asked was it from the Ministry's point of view, " don't do as I do but do as I say." He asked if they might not know what developments were proceeding and what in fact had been accomplished in regard to this activity of the Government Department.

E. L. Howe (British Petroleum Company Research Centre) said that his remarks were confined to three points on Mr. Webber's paper. Mr. Draper had already covered two of those points and on those he could only lend support to his views and supplement the information he had already given.

The first point he would like to comment on concerned the insulation of stacks with aluminium cladding to prevent the formation of acid smuts. Readers of Mr. Webber's paper might gain the impression that it was difficult to apply aluminium cladding to tall stacks. This was not so and several stacks up to 150 ft. in height had been fitted in this country. If slide projection facilities had been available he could have shown slides of some of those tall stacks. He would say, however, that the aluminium cladding method of insulation should be carried out by a contractor experienced in that work. Mr. Draper's company, he was sure, would be only too pleased to help and advise industrial concerns and recommend suitable contractors. Mr. Howe said his company also approved the use of prefabricated insulated stacks such as " Dribore " particularly for new installations. Whilst on the subject of insulated stacks he would point out that for new large plant such as power stations very tall stacks had been designed to give very low exhaust gas temperature drops. He knew of at least one stack on the Continent which was 150 metres in height and had been designed to give a flue gas temperature drop, bottom to top, of less than 5°C.

His second point concerned Mr. Webber's implication that maintaining the temperature of flue gases above the acid dewpoint would prevent acid smuts. Whilst that was a desirable flue gas condition to achieve, the crucial factor was the temperature of internal stack surfaces in contact with the gases. It was the temperature of those surfaces that must be maintained above the acid dewpoint, thus preventing condensation of acid.

His third point concerned the fitting of exit nozzles or venturi to chimney tops to increase gas effluent velocity. That development was not mentioned by Mr. Webber during his presentation that morning but was referred to in his paper. He was interested in that development particularly for existing small stacks which could not be increased in height also for existing stacks which were of such a diameter that they were too large for the capacity of the plant installed.

He would welcome any information from Mr. Webber regarding practical aspects and experience he might have obtained with this feature of stack design. It seemed to him that a note of warning should be given on the fitting of exit nozzles or venturi particularly if they were made of cast iron. Precautions should be taken to ensure that the temperature of the nozzle surfaces in contact with the flue gas were maintained above the acid dewpoint by shielding or other means. If such precautions were not taken he felt sure that such nozzles would be ideal acid smut producers.

Alderman W. L. Dingley (Warwickshire Clean Air Council) said that progress depended on research, as well as the application of what they already knew.

He did not think it was generally appreciated how much damage was done to health by air pollution, or the waste which took place when any gases went out into the atmosphere above the temperature of that atmosphere. Those two things together represented thousands of millions of pounds a year.

He said that when they thought they had enough research going on, they should then multiply it a hundred times.

He suggested that large prizes should be offered each year for ideas for the improvement of present conditions.

It was absolutely imperative that they should do everything they could to conserve their resources and get the "know how".

E. L. Howe (British Petroleum Company Research Centre) in a written contribution stated that Mr. Webber had expressed disbelief at the information which he had presented during discussion, concerning the designed gas temperature drop in a tall insulated chimney on the Continent. The 150 metre insulated chimney to which he had referred was fully described, including design details, in the German publication Mitteilungen der VGB Heft 66, June 1960, pages 186-190. In the same journal, pages 180-183, a special designed 220 metre insulated chimney at a power station near Hamburg was also described. For this chimney the designed exit gas velocity at full load was 25 metres per second and the gas temperature drop, base to top of chimney, was stated as 2°C. At low load the gas temperature drop, base to top of chimney, was stated as 8°C. He suggested that this published information was worthy of study and should not be dismissed as unbelievable by Mr. Webber just because he himself had encountered difficulties in measuring chimney exhaust gas temperatures.

Dr. Albert Parker (Royal Society of Health) in an oral and written contribution, said that he agreed generally with the views expressed in the excellent paper by Mr. Webber. He did not fully agree, however, with certain statements about the emission of oxides of sulphur from the burning of coal and of oil in boiler furnaces. The average sulphur content of British coals was 1·6 per cent.; but averages of wide differences could be misleading. This overall average included coals with sulphur contents ranging from less than 1 per cent. to more than 3 per cent. It was important, therefore, to know the sulphur content of the particular coals being burned. The sulphur contents of oils used as fuels ranged from less than 0·1 per cent. for kerosene to about 3 per cent for 200 seconds fuel oil and about 3·5 per cent. for 950 seconds fuel oil. Mr. Webber said that with coal a considerable proportion of the sulphur is absorbed in the ash. In fact, in boiler furnaces, only about 10 per cent. of the sulphur of the coal is taken up by the ash and the remaining 90 per cent. is converted to oxides of sulphur carried away in the chimney gases. In the Statistical Digests of the Ministry of Power, the heating value of 1 ton of oil is taken as equivalent to 1·7 tons of coal. On the basis of these two factors, for the same heating value, 3 per cent. of sulphur in fuel oil is equivalent to somewhat less than 2 per cent. of sulphur in coal. Mr. Webber also said that in firing with pulverized coal the fly-ash can remove a great deal of the sulphur dioxide from the chimney gases. In fact, fly-ash did not absorb any appreciable quantity of sulphur dioxide. It took up some sulphur trioxide but the amount could not be great as the amount of sulphur trioxide in the gas was no more than about 2 per cent. of the amount of sulphur dioxide.

Authors' Replies

J. W. Batey in reply to Mr. A. Wade said that there were many considerations governing the situation of a large power station the question of atmospheric pollution must, of necessity, be relegated to the background. This did not mean that the subject was of no importance, on the contrary it was extremely important to those who had to live within close proximity to the station, but the general position still remained; water supplies, location of industry, the nature of the ground and so on, must take precedence. He thought that coal would be the fuel of the future for large power stations.

In reply to Mr. S. Cayton, Mr. Batey stated that the wet type of grit arrestor was the best practicable means available at the present time for grit and dust arrestment on cold blast cupolas.

He would refer Mr. Howe to a paper which he had written in 1952, published in 1952, in the Journal of the Royal Society of Health (then the Royal Sanitary Institute), in which he mentioned the use of Venturis for gas dispersal.

W. J. Dickie, in reply to Mr. Iddison said this will to solve an industrial problem was only one of the three requisites, there must also be the knowledge of what to do and the means for doing it. This applied in particular to the problems encountered in the cement industry. The scale of operation was so large that equipment of 100 per cent. efficiency would be necessary to completely eliminate the pollution. No such plant had yet been designed and the total emission would still be considerable even if it were practicable to install equipment of 99½ per cent. efficiency.

In reply to Mr. Draper, it was first necessary to reiterate that an industrial chimney should rise sufficiently above surrounding buildings to ensure that little of the flue gas is drawn towards the ground by downdraughts. For smaller plants some relaxation of the 2½ times rule was desirable on grounds of cost and was acceptable because of the relatively small volume of flue gases. The F.B.I. recommendations were based on a limited number of observations by a technical committee which included a representative of Mr. Draper's group of companies. The F.B.I. Handbook clearly stated that these recommendations should be reviewed in the light of experience after two years. It was also suggested that those like Mr. Draper who did not like the recommendations should arrange for wind tunnel tests with a model of the proposed installation. Wind tunnel tests were made to determine how best to deal with the chimney discharge from the new (plus 364 ft.) Shell Company building near Waterloo Station, London; the solution was a high discharge velocity and alterations to the angle of slope of the roof. At the request of the F.B.I., the D.S.I.R. had recently arranged for the National Physical Laboratory to make a systematic study of possible modifications of the 2½ times rule for small buildings.

With regard to the last part of Mr. Draper's contribution the low chimney heights mentioned were correctly calculated but the over-riding consideration was the 2½ times rule; the extremely hot gases from even a small atomic bomb would rise to the stratosphere from a very deep hole.

C. M. Opie replying, said in regard to Mr. Draper's reference to the 2 per cent. of new chimneys that had been refused approval, that this had mainly been due to proposed new processing furnaces and chimneys to be installed near large areas of domestic property in the line of prevailing wind. It had been possible in most cases for manufacturers to install their new plant, with its fume possibilities, in another part of the works.

Certain areas in the country still had cause for complaint from dust escaping from cement works and grit and dust from some power stations. No grit and dust arrestment plant had yet been proved to be 100 per cent. successful. An efficiency of 97 per cent. still left a serious localized problem in some areas and the difficulties were both technical and financial.

In reply to Mr. Wade regarding the best fuel to use in large power stations should they be erected nearby to large centres of population, Mr. Opie said that this aspect was governed by two main factors (*a*) the country required cheap electrical power and as the cost of fuel in relation to its calorific value was the main factor, coal was the fuel which most satisfactorily supplied this requirement, and (*b*) those areas where it was very probable that a local problem from dust emission would be caused had good reason to press for the type of fuel from which no solid chimney emissions were caused.

A. F. Webber said he was glad to know from Mr. Draper and Mr. Howe that aluminium cladding of steel stacks had been used for comparatively tall stacks and had proved satisfactory, and he agreed with Mr. Howe that it was really the metal temperature which mattered, though, of course, if this was too cold it was the resultant cooling of the adjacent gas below the dew point which actually caused condensation.

As regards exit nozzles or venturi at the chimney top, this was only a suggestion of his as a way of giving a fairly high effluent velocity to the gases without an unduly slender stack throughout, and he had no knowledge of any case in which that had actually been done.

He agreed with Dr. Parker that the sulphur content of fuels must be related to their heat content, and regretted that this was not made clear in his paper. It was still true that even on this basis the sulphur content for 3,500 seconds fuel oil was higher than for almost all coals.

As regards sulphur absorption by ash, Mr. Webber thought that Dr. Parker's reference to only 10 per cent. absorption referred to power station boilers, and combustion conditions could be quite different in shell type boilers, which he had chiefly in mind. It was certainly true that P.F. fired Lancashire boiler plants seemed to be able to work without corrosion problems at an economizer outlet with gas and water temperatures at this point substantially below the figures at which one would normally expect corrosion trouble.

Mr. Webber still thought that the well-known difficulties (not only his own experience by any means) in ascertaining the true average gas temperature in flues, ducts or chimneys of any size, were such that an accuracy of the order of 2°C. could not really be attained.

INDUSTRIAL QUESTIONS AND ANSWERS

Chairman : Dr. J. L. Burn ; Panel : J. W. Batey, W. J. Dickie, H. A. Haines, Dr. A. Parker and A. F. Webber.

The Chairman, Dr. J. L. Burn, introduced the platform panel, and then read the first question, from Meriden R.D.C. " There are indications that in Warwickshire the public health function of school chimneys is being overlooked. In some cases these chimneys are below the roof levels of nearby buildings. The County Clerk has contended that the County Council when building schools were acting as agents for the Ministry of Education and they could, therefore, claim Crown exemption from byelaw control.

Does the panel agree that these chimneys are outside Clean Air Act Control and if so, do they think they ought to be? "

A second question was then read: " The gas boards claim exemption from bye-laws over gasification plant. They say they are agents for the Crown and therefore exempt from the requirements of the Act."

J. W. Batey: This appears to me to be largely a legal problem. Perhaps we should take a page out of the leaf of Nottingham, who in spite of the Crown exemption went to the High Court where the judgment was given against them. Although they lost the case they gained a lot of glory. And of course in the process the hospital that they were complaining about put their house in order. As for schools I don't think there should be any doubt at all. Surely this is a local authority job? Local authority officers together with the Councillors ought to ensure that the conditions of chimney height and what is coming out of the chimney, are satisfactory in every way. Surely they ought to lead industry? We expect them to do this, and we expect our universities to lead us. Schools should have no exemption, I can't see why Crown properties have ever been exempted under the Clean Air Act. I am quite sure that it is a by-product of a past age.

Dr. A. Parker: I think the obvious thing to do in the case of justifiable complaint against Crown property is to take it straight to the Minister. There should be no difficulty with hospitals and schools because of well-known systems of heating without producing smoke. As for sulphur—then it is a question of chimney height, and there should be no difficulty whatever. If the chimney is not properly designed or operated then you should go straight to the Minister, or in the case of schools, the local authority should operate, although I don't know that they have the last word on the height of the chimneys. With regard to gasification plants my impression is that they would come under the Alkali Inspectorate and they would see that everything possible is done to reduce the emission of polluting effluents and to see that there is proper dispersion from a properly designed chimney of the right height.

The Chairman: May I say that the Alkali Inspectors have often pointed out that until the plant is erected and registered and completed and ready for operation they say that the local authority should deal with the matter.

A. F. Webber: Supposing in a public baths a boiler for heating the baths, owned and operated by the local authority, starts belching smoke into the atmosphere. What does the local authority do? Do they solemnly warn themselves, or do they actually go so far as to prosecute themselves?

Chairman: This is a matter for Warwickshire, so we'll ask Alderman Dingley to answer for his Clerk, if he can.

Alderman W. L. Dingley, Warwickshire Clean Air Council: One should always act in the spirit of the Act and not necessarily see how one can get out of it in a legal manner. As far as Warwickshire is concerned I shall endeavour to see the matter is rectified.

Chairman: The next question: "Pollution from road vehicles is not dealt with by the Act. Would it not be preferable for Health Department staffs to enforce the provisions with reference to road vehicles?" Are there going to be more jobs for the boys? Should health department staffs be enrolled in an army to deal with pollution from road vehicles?

New Speaker: A man must be in uniform before he can stop a road vehicle and that is one of the big objections. It was tried, I understand, in London before the war and it was proved conclusively at that time that it was illegal for a person in plain clothes to stop a vehicle and try to prosecute. There is an obvious disadvantage. You are going to have a second police force if you have uniformed people doing that sort of work.

New Speaker: What would happen to a local authority official who chased a vehicle and ran over his boundary into the area of the next local authority?

S. Cayton, West Bromwich: I cannot see that anything would be gained by giving to the Public Health Inspectors or any other of the local authority officers, this task of trying to deal with something which has always seemed to me to be a police matter.

Chairman: Another question relates to a new type of industry where there are noxious fumes and smells of new kinds of chemicals. For instance in certain plastic processes.

The making of plastic and rubber goods often brings about an emission of sickly sweet fumes which does affect the health of people round about. There is such an industry in my area. Unfortunately this factory is in the middle of a very large number of houses and the health of children is affected. The firm has indicated that the factory may have to close down and go elsewhere. There is the implied threat that some of the men might become unemployed. What would you do in such circumstances? Can you afford to shut down the plant? These plants are very few in number and involve complex modern processes. In our case I think it is a plant of which there are only two in the country, and one in America which is situated some ten miles away from houses. The best practical means have been used to try to prevent this emission, but still on some days, there is an accident or a breakdown and a nuisance is created.

Dr. Parker: I doubt whether this is really a question of closing down the factory. Usually this is a problem of absorbing or burning the vapours coming out with the gases. The local authority should engage a consultant who knows something about chemical processes.

W. J. Dickie: In my experience of this type of offence, it always pays to have somebody thoroughly conversant with the problem to look around the factory and see if eveything has been done which is reasonably practicable. Very often some simple solutions can be applied, which even if they don't cure the emission, mitigate it. Very often it can be traced to one or two particular points in the plant, and if special attention is paid to those points, and precautions taken to see that the odours don't leak around the plant generally, it is often possible for these odours to be conducted through a chimney which dissipates them at a sufficiently high level. Another point is that sometimes the gases which give rise to these odours are combustible, and it is a simple matter to duct them into the factory boiler plant where they will burn—sometimes they are soluble in water, and can be passed through a water spray. I am not satisfied that something cannot be done in this particular case.

Chairman: This is evidently a unique problem. The next question from Mr. R. G. Goodbody, Chief Public Health Inspector, Shoreham-by-Sea: " Have there been any recent advances in the methods adopted to minimize the nuisance from dust caused by the unloading of coal from ships and railway trucks, and the screening and handling of this material in coal-yards? " Shunting yards and coal yards have been a source of nuisance in the past.

H. A. Haines: It is very much a question of the moisture contents of the fuel which is being handled, and a lot of work has been done on wetting coal before handling it on conveyors and delivering it to bunkers, etc., but it is a very difficult thing to do effectively, particularly by using water. It is better to do it with steam, but of course steam is expensive.

Mr. Dickie: I have sufficient faith in the knowledge and experience of the manufacturers of dust arresting and collecting equipment in this country to know that they can tackle any such problem which is put to them. The only point that arises is whether those who are responsible for creating it can afford the means of arresting it. There is no reason why it can't be done. It is just an economic problem.

Chairman: We might as well take another question about railway engines. " Railway engines are subject to provisions of Section 1 of the Act. In view of the type of fuel available for shunting purposes and the loads hauled by the engines, would legal proceedings materially assist in the reduction of smoke pollution? Is not the whole question intimately bound up with general economic resources for diesel/electric replacement and the nation's dwindling coal supply? " Would anyone care to comment on that?

New Speaker: This is a problem that is rapidly passing away because shunting engines will be converted to diesel, and long-distance trains will be diesel or electrified. It is just a matter of time and I think this problem will disappear.

Mr. Webber: I think this is a little optimistic. Perhaps I might state that I speak as an Associate of the Institution of Locomotive Engineers—an unexpected qualification. It is a little optimistic to assume that the replacement of a steam locomotive by diesel haulage is going to solve all smoke pollution. On Monday I watched the 3.45 diesel train pull out of Birmingham Snow Hill for Stratford, Bristol and Cardiff. As soon as it got going, clouds of dense blue smoke arose from eight jets, and for some minutes after the train had drawn out, the air of Snow Hill station—and the centre lines of Snow Hill station are fairly open spaces, not closed in by a low roof—were still blue with smoke. The diesel engines on diesel trains are not as hot as they were when they started. It is one thing to compare brand new diesel sets with 40 or 50 year old steam locomotives, but I don't think the whole problem of atmospheric pollution is going to be solved by the switch from steam to diesel.

Mr. Dickie: I have often wondered why in the case of the works locomotive a greater use is not made of the fireless locomotive, that is the steam storage locomotive. It did have a vogue at one time, and is very useful for shunting around the average works. The loco as you probably know is charged up with steam at the works power station and can store enough to run it for several hours. This seems to be a simple and relatively inexpensive means of combating the smoke nuisance from locomotives.

Mr. Batey: The steam storage locomotive is going out because it has been proved uneconomic; nobody would claim that the diesel is the perfect answer to smoke from shunting engines, but it goes a long way towards it—there is no reason why it should emit large volumes of smoke at all if it is well maintained, as it has to be to do its job. And finally with any serious smoke emission from locomotives, if one can get a prosecution home—we in Sheffield got one home this year—it certainly has a livening effect on local officials who take particular notice and do their best if they know a local authority is alert.

Chairman: A question from Scotland. " Have the members of the panel any knowledge of regulations for the control of chimney heights in Europe or overseas generally? " I think we might take it with another question on chimney heights. " Would the panel like to comment on the question of chimney heights in relation to the architectural aspects of new buildings—that is, the disturbance of architectural design caused by requiring higher chimneys? "

I wonder if there is a millionaire in the audience who would be prepared to give a prize to architects for designing effective yet beautiful chimneys. Nobody seems to have paid any attention to it at all. The most awful horrors are put up. People often complain that doctors make mistakes and bury them, but architects erect theirs and I feel something should be done.

J. Innes (Paisley): All that I would say is that it is quite common knowledge that one of the objections when new premises are being erected is the disturbance of the front elevation as the architects call it, by the disfigurement of a tall isolated chimney. This is repeatedly arising and it seems to receive a certain amount of sympathy from those who are least expected to give it. I believe that many officers meet this problem but our main aim is to prevent the emission of smoke or fumes affecting the public, and we are not too concerned with the effect on the eye. But I think that something might be done about it. Perhaps the Chairman's views might reach the appropriate ears.

J. Green (Reading): I have had something of this kind to deal with in the past. It is my view that where the architectural features are likely to be interfered with by an unduly large chimney, the people concerned should seriously consider, or the planning authority should require, some different form of heating which would not need a chimney of that sort.

T. Henry Turner (Individual): I should like to link this up with what we started with—because in Derby the gas people put up two new vertical retort houses and their architect didn't want to have a chimney showing. The result was that the sulphur measurement, in the gauge that I had quite near to the gas works, doubled. If you build a rectangular building, and you are burning the poorest quality of coke—coke breeze—to provide heat to gasify the coal in the retorts, you have something like what comes out of your kitchen coke boiler—and you know how sulphurous that can smell—coming out in great quantities from the top of a building on which the architect has put four little sort of tiles in order not to have them stand up and look like a factory. The electrical people put a whopping big chimney, and they carry the fumes away well distributed, but it is literally true that the sulphur content measurable on the ground is doubled because the wind sweeping over that building without a proud chimney brings the sulphur fumes down to ground level again. Unfortunately towns have grown around their gasworks, so this problem has become worse because the gasworks were at the edge of the towns when first built and the towns have lapped around them and property is now suffering as a result. I think that it is time the Society contacted the Royal Institute of British Architects and asked whether we couldn't have a representative of that institution on our Council, co-opted perhaps.

Dr. Parker: Obviously chimneys must be high enough to give effective dispersions. In my view many of the tall chimneys erected now and in the last few decades, are ugly. They could be improved by architects, but a chimney with an improved appearance would cost more. You have examples of attractive chimneys in some of the old woollen factories, for example if you go to Chipping Norton, in the Cotswolds, down the hill, you'll see an old woollen factory, a beautiful building with a chimney which is an ornament, but I have no doubt it would cost a lot of money now. You can go and look at the clock tower of the Birmingham

University at Edgbaston, a great tall tower that might equally well be a chimney—the cost would be pretty high. The trouble is that architects don't like chimneys, and I remember one architect designing gas heating for a house who so disliked chimneys that he put the flue into the loft of the house with vents to carry away the gases. He also had copper nails for the tiles of the roof, and the roof had to re retiled after a few years.

Mr. Dickie: I have come across one case where the Town and Country Planning Authority of a department of a local authority has been at complete variance with the engineering department on the question of chimney height. I was asked to investigate a particular case six months ago and I found that the City Engineer's estimate was correct but he could not prevail upon the Town and Country Planning Department to accept it. They argued that the town would take on the appearance of a pincushion if the engineer had his way. I think it is up to local authorities to solve this problem among themselves. Regarding the design of chimneys I would strongly advocate that embellishments of any kind are thoroughly investigated because we all know that downwash is an important feature in connection with chimney design and dispersal of flue gases and some of the old ornamental chimneys which we see, are very susceptible to downwash—you have only to notice that at least one side of them is badly blackened. They look very attractive, but they are not efficient. I feel that the architect can however do quite a lot. I have in mind the design of the chimneys on Battersea Power Station. They are simple and they certainly look attractive and are effective.

Chairman: There is an excellent film strip called " Air Pollution " which I think is on display or at least some of the photographs are on display at the Central Electricity Generating Board stand in the Exhibition. You will see there a very bad modern chimney on a block of flats in Wimbledon erected a few years ago with appalling downwash, very black and very ugly. You will also see a picture of the highest chimney in the world. Of course it had to be in America. It is the Kentucky and Ohio Electricity Board and I think is 740 feet high. I don't know what the pilots of aeroplanes think about it all but I think it looks rather beautiful.

It had been asked if there were any knowledge of regulations for the control of chimney heights in Europe or overseas generally—the fact is there are not. I have made inquiries from several countries and there are no regulations whatsoever. There is however something much better in some countries, which I think we might well follow. At the planning stage—this happens in the Ruhr Valley and also in Venice—the architect, the town planner, the health officers, the medical officer and the equivalent of the health inspector, the industrialist and representatives of the general public all meet round a table and plan. They site the factories and the houses in the correct positions, having due regard to meteorology, and by the way a meteorologist comes, and he advises about the weather and prevailing winds, and so a decision is taken and heights of chimneys are considered and decided there and all agree to abide by the findings. I feel that is most effective and I would like to see something more of that in this country. People getting round a table and agreeing, planning wisely, every relevant interest having its say and a good result at the end.

Chairman: The next question, from S. Pape, Deputy Chief Public Health Inspector, Eton Rural District Council, concerns roadmaking, an interesting point which several authorities have raised. " Could grit and dust from an oil-fired asphalt roadmaking plant be considered as coming within the definition of Smoke as defined under Section 34 of the Clean Air Act, 1956, in view of the fact that the grit and dust are entrained in the flue gases which pass out of the stack after treatment in the cyclone arrestors? The combustion conditions of the furnace are satisfactory. If the answer is in the negative, is it considered that there is a need for amendment to the existing provisions of the Public Health Act, 1936, to deal with this problem which owing to the vast increase in our road building programme is likely to be increasingly encountered in the future? "

Mr. Batey: In the Clean Air Act " smoke " includes soot, ash and gritty particles—that is the legal definition as I understand it. It doesn't say what it is, it just says it includes that, and I don't see any reason why you shouldn't treat it as smoke. The point of course is that it isn't black smoke normally and it isn't dark smoke—it is coloured smoke, and of course if it is coloured smoke it has the " best practicable means " defence. I rather doubt that the problem will be met an increasing number of times. From my own observations it doesn't seem to me that we have any great problem in my area from these machines. I may be wrong, or we may be fortunate, but I can't see why it should increase. Roadmaking materials are now made in large central plants and brought to the road, and I would have thought that the local nuisance is quite small. There is a more important nuisance I have found, and that is the burning up of the road by naked flame when the City Engineers get on the job. I have often thought it would be quite simple to devise what I might term a hotplate, where the flame is contained within a casting and the plate is heated up and brought down to the road surface to soften the asphalt before the engineers start picking it up.

Chairman: Mr. Batey has dealt with a point which brings us to a question which we might take now, in association with the first one. It is from Mr. Clarkson, Chief Public Health Inspector of Blackwell Rural District Council. He refers to " The flames which are used under a large hood for heating and planing tarmacadamed road surfaces. The flames are in close contact with the road surface, which is invariably ignited and causes in the immediate vicinity large quantities of dense black smoke. Frequently flames from the machine project from underneath the hood and increase the nuisance by igniting hedgerows, damaging paint and woodwork of adjoining property, and the heat has been known to crack plate-glass shop windows. These machines cause a smoke nuisance. Previous complaints have been made and referred to the Road Research Department of the Department of Scientific and Industrial Research, but the procedure did not produce a satisfactory solution. Can this type of machine be improved so that the smoke nuisance is eliminated, or alternatively, should representations be made with a view to eliminating the use of such machines? "

W. H. Wattleworth (City of Liverpool): There is another point—if you decide to take these things under the nuisance clauses, you still have this problem of trying to prove that it is a nuisance to the residents. If a machine is going down a main road there are shopkeepers and factory people and not residents in the locality. Those people begin to move as soon as it is 5 o'clock and of course they go out of the area. The workers are not residents. We have been belabouring a poor old lady, the only house in a smoke control area, to try and give a complaint so that we can take some action over a similar nuisance to this. So technically we are up against this. But I must say this, that when we first met this problem, it was mainly on incineration—smoke from rubbish, though the incinerator itself was quite a good one. We brought the incenerator people together and they have now provided us with the complete answer in a first-class incinerator. So the answer here is that technically it can be solved, whatever smoke you get, providing you get the technical experts together with the practical legal experts, and with a small working party on the smoke, usually we arrive at a solution.

W. Combey (Oxford): Some years ago when we started our smoke control areas in the centre of the city we had trouble with local firms planing roads, and following a meeting they got down to brass tacks, and produced what I believe has been patented, an addition to the machine which completely eradicates the dense volumes of black smoke from the road planing machines. Why it hasn't become of more general use I don't know, but certainly when that firm is operating its machines in Oxford we have no smoke nuisance at all. Whether it is possible to get details of this machine for general use, I do not know.

Alderman Dingley: May I ask for information here with reference to the point raised by Mr. Batey. Are they merely softening the surface or am I not right in saying they are actually burning off the excess bitumen which they want to get rid of?

Mr. Batey: No, it is a softening process.

Alderman Dingley: There's no doubt that dense black fumes arise and I should prefer to take proceedings not only under the Clean Air Act, but under the Cancer Act.

Chairman: The Cancer Act of 1939 has been repealed. I think these dense black fumes on tarmacadamed surfaces at heat cannot but be harmful to the human lung. They must be got rid of.

A question from Scotland: " Has the panel any observations to make on the question of soot-blowing in oil-fired boiler plant, and on how to control this? "

Mr. Dickie: I am not sure what the questioner has in mind. Soot-blowing in any boiler plant should be done when it is necessary. I think it is important in this connection to refer once again to the results of the investigation carried out by the British Standards Institution into the amount of smoke emitted in well-operated plants. In both the publications there is a reference to the amount of smoke made during soot-blowing operations. It was found that in some cases the frequency of blowing was too high and in others too low. If soot-blowing is resorted to at too great an interval obviously there will be a greater amount of deposit moved when the blowers are operated. The manufacturers very often can give a useful indication as to the interval between the frequency of blowing. Very often however it is also necessary to establish what that interval should be from practice. There is no doubt that soot-blowers are an important aid to efficiency and long hours of steaming between cleaning, and I advocate their use in every boiler plant, but they must be used intelligently, and if they are, will not offend against the regulations as the results of the experiments to which I refer show.

Mr. Webber: Just a supplement to what Mr. Dickie has said. One of the troubles is that they go on blowing for too long when they do blow. If you work out the whole question of gas feeds and that sort of thing you will see that about five seconds is all that is required but the men in charge, not unreasonably, like to do the job thoroughly and will go on blowing for 15-20 or 30 seconds, quite unnecessarily. That is more disturbance than there need be. The only other minor point is that of course the practice of soot-blowing after dark is common in industry.

Dr. Parker: This question refers to soot blowing with oil-fired boilers. There should really be little trouble if the oil firing is efficient because the amount of soot produced from oil-firing boilers is very small in relation to the amount of oil used. But taking the smaller oil-fired boilers, industrial oil-fired boilers, I know of one case at least where there is the equivalent of vacuum cleaning so that you do not get the soot blown out of the chimney.

Chairman: May I lead on to a question about the emission of dark smoke at night, from London? " Many industrial boiler plants and furnaces are in operation during the hours of darkness, when it is not possible to observe the emission of dark smoke. Has the Panel any knowledge of whether smoke emission, and soot-blowing, is greater during darkness than during daylight, and if so what kind of control should be used in place of observations with the Ringelmann

Chart?"

New Speaker: I think that it is fairly well known that most people who are soot blowers blow in hours of darkness, because the gentlemen who are looking after these things are then in bed.

There should be no difficulty. I think one of the difficulties is that people do not soot blow frequently enough. The manager or chief engineer should put down the periods when he wants soot-blowing to be done. If you allow it to accumulate for days until a particular fireman is interested enough to use the soot-blowers, then you are bound to get dense emission which causes a severe nuisance. But intelligent use of soot-blowers will minimize this, but of course it will always be a nuisance and that is why it is included in the Regulations. One is allowed to emit dark smoke while soot-blowing. As regard the oil-fired boilers if you put into practice all the good advice you had this morning you would do away with the major cause of smuts which is the condensation on the chimney bottom, and therefore when you soot blow you should have a smaller emission. But of all the plants I have visited there are very few industrial plants burning oil that are fitted with soot blowers.

Chairman: It is evident that Public Health Inspectors and Smoke Abatement Officers in particular will need the nose of a fox and the eyes of a cat. In my experience it is generally at quarter to six in the morning, summer or winter, that is in light or in darkness, that these blowing off processes occur.

Question from Birmingham: "In certain cases equipment has to be approved by the local authority. If this approval is given, does the local authority accept any share of responsibility for the results—if not, what is the value, or indeed the point, of any approval?"

This is a hot one, because we all worry about what we approve and sometimes undoubtedly mistakes are made and we are found out by Father Time ten years after.

Mr. Haines: If you approve an appliance and we at N.I.F.E.S. are often called to help local authorities, and so are the consultants; one of the things we always put in, I hope you do, is "provided the plant is operated properly". You can have the most expensive plant in the world, but if it is not operated properly it will still cause smoke and grit emission. So I feel that if every precaution is taken with your own resources and the resources at hand, and if you approve an appliance, you cannot be held responsible if someone through mal-operation or not enough maintenance allows it to get into a state where it emits smoke and grit.

Mr. Webber: This is a point which has been worrying me. I'll take a specific, if hypothetical example. I am designing an economic boiler plant for my clients, and I think that a simple Scroll collector grit arrestor will be adequate. We go to the local authority and they approve it. Well supposing I have made a mistake—the condition of the fines and the boiler operation, assuming that everything is being worked properly. Of course, if the plant is perfectly good but they are fooling about with it, that is another question altogether. But if I have made a mistake, (and we all ought to remember Dr. Johnson's dictum: "Depend upon it, Sir, a fallible being will fail sometimes."), it is then clear that I was wrong; that it needed the more expensive but more efficient multicellular collector. Grits are being emitted when they shouldn't be. The local authority has approved the Scroll collector and has said that will be satisfactory. Remember it is being assumed that everything is being worked properly. It has in fact proved inadequate. Right; has the local authority taken from my shoulders any of the professional responsibility I bear to my clients? If there is no question of approval you see, if I'd put in a Scroll collector and advised my clients accordingly, and it had proved inadequate, my clients could come down on me. They could say "You have misled us. You ought to have known that under these conditions of a very high proportion of fines in the coal, or whatever it is, we ought to have had a multicellular ". And a professional man can be liable in those conditions, for substantial damages. But has the local authority in a noble spirit of self-sacrifice, stepped forward, approved it, taken the responsibility from me?

Mr. Batey: I am delighted to be able to help Mr. Webber, who has helped me in the past. The local authority have no power to approve a grit and dust arrestor. I would refer the questioner to the Act, Section 3, which says that new furnaces, when they are installed, can be approved by the local authority to comply with this Section, which deals with smoke only. It states that they must be so far as practicable smokeless, and it says nothing whatever about grit and dust. So there is no need to worry, Mr. Webber, about your Scroll collector. What is more, the local authority are still empowered to take action, even though they have given their approval, against that particular plant if it makes smoke.

Mr. Webber: In dealing with public authorities of any sort, and I hope I shan't be offending those of you who represent local authorities, I'll tell you plainly, you are engaged in a game entitled in other circumstances " heads I win, tails you lose ". If you emit grit, they pull you in, because smoke includes grits. But now, if that principle works against them, they discard it. They are not unprincipled, oh no, they have far too many principles. They always have a principle ready bridled and saddled in the stable to trot out to suit them.

This is on Section 3, but what about Section 6? " No furnace in any building, pulverized fuel,"—we'll forget that for a moment—" burn at the rate of one ton an hour or more, solid fuel," and so forth, " unless the furnace or oven is provided with plant for arresting grit and dust, which has been approved by the local authority, or which has," of course you must have lots of " ors ", " or which has been installed in accordance with plans and specifications submitted to and approved by the local authority ". Well, what does that approval mean in practice? I have designed the plant, I've provided large drawings at enormous expense, I have submitted, or my clients have submitted, my drawings to the local authority, who have approved them, and between us all, we have made a mistake. Who is responsible?

Dr. Parker: I am interested to hear from Mr. Webber about the large amount of money spent on the drawings approved by the local authority. In my opinion, if a local authority approves a plant, although they may legally be entitled to take action for emission of smoke and so on, if the plant is properly maintained and operated and still produces smoke, it seems to me that they are morally bound not to take action, but of course it will all rest on whether the plant is properly maintained and operated. Of course this question rather indicates that somebody approves plant and that when it is put into operation it doesn't work, which reminds me of the lady who bought one of the new safety belts for her car, had it for 3 months, and said, " It's not a scrap of good—I've had just as many accidents since I put that on as I had before."

Chairman: Now, what about local authority approval? In some cases we'll always be wrong, whatever we do.

Mr. Cayton: I think there is something in what the Chairman says. We are nearly always wrong. In slum clearance for example—if we say the property's pink and unfit, it's wrong, particularly if it happens to be next door to a property which we have classed as grey and said we think is fit. I don't think there is much more that can be added, except this, that perhaps we would go to a competitor of Mr. Webber's and seek his expert advice as to who had made the mistake.

Mr. Dickie: I think this question could be easily resolved. When the local authority examine plans and they see a particular type of grit arrestor specified, they know quite well, or they can easily find out, what efficiency that arrestor is expected to give. It's obvious that there might be some misunderstanding on a small point, but the question of whether the arresting plant is wholly inefficient, or reasonably efficient would never arise, unless the local authority didn't know anything about it whatsoever. I don't think that there ever will be a question arising of whether the plant is seventy per cent. efficient, or seventy-three or seventy-four per cent. The problem will only arise if the plant should prove to be 30 per cent. efficient whereas it would be reasonable to expect it to be 60 or 65 per cent. efficient.

Mr. Batey: I have been given the opportunity of adding to my remarks. I ought to say that no approval is necessary for grit and dust arrestment on furnaces if they are of a capacity of one ton an hour or less. Does that satisfy Mr. Webber?

Mr. Webber: If I may say so once more, I think that they are haranguing the audience a good deal. Supposing you put in a battery of four boilers with eight furnaces, has each furnace got to burn a ton an hour? If so, that clause of the Act is just waste paper. There are very few single shell boiler furnaces in which you can burn a ton per furnace, which would mean two tons per boiler which would be about 30,000 lbs. of steam from a single boiler. If a furnace is to be treated in the way in which the boiler-maker or boiler designer thinks of it, well we've got a free hand and need not bother about the Act. But I have been informed that it applies to the total number of stokers or whatever it is working to the stack. Then it's no good talking about this one ton per hour as letting everybody out. I think that the question is still unresolved.

Chairman: I want to come clean and say that I think a mistake was made by the Beaver Committee about this ten tons an hour.

Now I would like to give you a chance of putting some spot questions, of which we haven't had any notice at all but you could put them after we have discussed this question. Here is a question from Mr. Adcock of Ilkeston. " The southern end of my town is a large ironworks. The District Alkali Works Inspector is doing what he can, but how can one convince householders that they must not produce domestic smoke when they are subject to industrial smoke, grit, dust and fumes every day coming from the ironworks? " Now there was part of this question this morning; the question of successful smoke control areas being instituted, and yet somebody else's chimney, some other railway engine, some other ship, some other chimney not mine, is doing the job. What are we to do—must we remove all the industrial smoke before we tackle the domestic?

Mr. Batey: Well I'll volunteer to give a half-hearted answer and that is of course not to make your first smoke control area next to your steel works. Of course that is not a solution to the problem, but have we a solution to all the problems that arise in running a steel works? I am afraid the answer is not yet. It's on the way, I have little doubt about it; but you have to face the facts, and you have to act accordingly. You have to put a maximum pressure on the firms, on the Alkali Inspector, on anybody who comes to hand, to get the position remedied, you have to get the best that you can out of the firm and after that you cannot do any more.

Chairman: A question from London: " In view of the proposal to make certification of furnace operators compulsory, and having in mind the present City and Guilds Syllabus for the Boiler Operator's Certificate, is it considered that the average furnace operator is capable of passing this examination? "

Mr. Haines: Well, in view of the experience we have had during the last seven years, with the Boiler Operator's Certificate, Boiler House Practice, the straightforward answer is yes. Actually the figures are that 80 per cent. of all the people pass the examination. There is a reason for this. One of the reasons is that the City and Guilds made a very good job of that syllabus and the form of examination. It is asking a lot and they realize that, to get a man of 40, 50 or 60 to go back to school, because that's how he looks upon it. It was not an easy problem at all and I would like here and now, to pay tribute to the Advisory Committee, of which Mr. Duguid is Chairman, and the Moderating Committee for the very good job they made of that examination paper. It has three sections, A, B and C type of question. The second part is made up of short answer questions, only four or five words, and then you have the normal type of question. And they give them plenty of time to do it, and provided he has the right solutions, any man unless he is absolutely illiterate, should be able to get the Certificate. And the facts and figures prove it. I would like to pay tribute to Brighton Technical College as we are at Brighton, because they have for many years put on courses for Boiler House Practice, City and Guilds, and I believe they are now doing the Boiler Operator's Certificate. They have led the way in this; unfortunately the biggest snag that has been met is that most of these people are on shift work, which means that they can only attend one lecture or two out of three, depending which shift they are on and it is extremely difficult to arrange technical college courses to accommodate the shift workers. That is why N.I.F.E.S. started this training scheme for boiler operators, which is really a correspondence tuition course backed up with practical training on the site. It has been very successful indeed, and I think the oldest member was a man of 72, who said he would like the certificate because he was retiring this year. I see no difficulty at all in training these people, and teaching them the elements of chemistry, the elements of combustion, the use of steam tables—even water treatment questions are answered very well. I would go further and say that of the 20 per cent. who cannot pass the examination after making a good attempt, they should not be in charge of a boiler plant.

Councillor C. A. Watson (Scunthorpe): I do not wish to utter one word to cast any reflection on N.I.F.E.S. or any organization of that kind which is dealing, very successfully, with the training of boiler operators; but let us look at the picture not in parts, but the whole picture. Now we have heard of the good work of the Brighton Technical College, and I assure you that you can go all round the country and get equally good work done by technical colleges. Is one to assume from that that the vast majority of stoking is done in areas where there are technical colleges? I come from Scunthorpe, it is a town reasonably important in the iron and steel industry, with a population of about 67,000. Our nearest neighbours of any size are either 20 or 30 miles away, but we are not specially peculiar in that. We have a technical college, but even so we cannot get enough people volunteering for boiler minders' courses for it to be worthwhile for a technical college to set up classes. And one of the reasons of course is that the vast majority of people in the town, are working on shift work in the steel works, and if a man is a boiler operator in Scunthorpe it's a thousand to one that he is a shift worker, and that's one of the reasons he can't get to classes, so that while it may be true that in the conurbations there are such things as technical colleges, that the training of boiler minders, properly, is effective and efficient and is doing jolly good work, I would suggest that I doubt very much whether that number of boiler operatives is anything like 50 per cent. of the rest of the country, or 50 per cent. of the total number of boiler operatives in the country. So it may well be that you can do an excellent job for 50 per cent. of your people who operate boilers but you leave the other 50 per cent. high and dry, and it may well be that in a classroom you can start talking about the theory of combustion and things of that kind, but in a correspondence course it is a vastly different thing: so much so, as far as Scunthorpe is concerned that the firm I worked for, Richard Thomas and Baldwins, started operating a training course at the works, in works time. And we were reasonably successful, but you see that is an establishment employing well over 2,000 people. What about the places where there are one, two, three or four boiler minders in the town? And it is that side of the picture which makes me sceptical of the thing we were talking about yesterday. Is it to be true that unless he can get his City and Guilds Certificate or something comparable, that after five years from the passing of the Act, he cannot operate a boiler. I come back to that point deliberately because there are a very large number of individuals who under what I regard as being the interpretation of the proposed Act, will be out of a job.

Councillor Newsholme: I believe the gist of the question was is it fair or possible that the average boiler operator should pass this examination. Well I might say this, I count myself as an average, normal working man. I went to school till I was 12 years of age, that was during the '14-'18 war. I never did another day's schooling until I went back when I was 30 years of age and got that Certificate. I passed it I think well enough. I eventually became a boiler foreman; I was able to work out the efficiencies of my boilers on the pounds of steam per pound of fuel business, and I think that is sufficient. There is one other point. If the Public Health Inspector can't pass his examination he doesn't become one, and I think the short answer to this thing is this—if again Conference will forgive me for repeating this point—that if the incentive at the end of it is big enough, as it normally is in all other jobs where an examination is to be passed, these men will pass that examination.

This seems to pose the question of academic qualifications versus practical experience. And it seems to me that if you have a man who does the job and does it satisfactorily, and knows how to do it and does it, surely he should be allowed to be given that certificate.

G. Drabble (Chief Public Health Inspector, Chesterfield): My question is one bearing on Mr. Dickie's paper, concerning the gas industry. He did say in his paper that developments, research and so on, had now reached a stage when the emission of smoke within the statutory limits could be effected during the changeover period. Does that apply to all the plants or is that only in new plants which are being designed for industry at the present time. I have such a case in my area, and it is claimed there that during the reversal period there must be a certain amount of emission which is well outside what we consider to be the statutory limit.

Mr. Dickie: Reference was of course to the old plants, but I would suggest that full information be obtained from the reference which I give in the paper. It is quite true that during the reversal period there must, even on new plant, be a very short period when there is some emission.

Chairman: The next question from Councillor R. Barstow of Audenshaw Urban District Council: " Does the panel think that if the Central Electricity Generating Board's experiment with closed circuit cooling, that is dry cooling towers, at Rugeley generating station is successful, it will then be possible to build power stations where river water or sea water is not available, and then site them either on top of a coal mine, or at some other economically justifiable position, perhaps well away from a city where atmospheric pollution is already a serious problem? "

These closed circuit cooling towers —I don't know whether you have recently seen photographs in the newspapers where cooling takes place without water—are remarkable erections. Then siting these power stations on top of a coal mine—may I say that this is already I think policy where practicable; I know a coal mine within a mile of my own house, where there is a conveyor belt which conveys it over a road right into Agecroft Electricity Generating Station, so that is already done. Utilization of quite low-grade coal and by means of conveyor belt transmission thus avoiding a great many problems. Does anybody know anything about it? If not, we'll go on to the next question—one which is always cropping up—several authorities are raising it:

"The premises controlled by the Alkali Act may not be subject to proceedings under Section 1, 5 or 16 except with the consent of the Minister, the Alkali Inspectorate being responsible for the provisions of that Act. Would there be any useful purpose served by local authorities being authorized to institute proceedings in respect of emissions from such premises?" Any defenders or attackers of the Alkali Inspectors here on the panel, or in the audience?

Councillor W. A. N. Jones (Birmingham): We have had difficulty in regard to a tar distillation plant very near our city—quite well within the city boundary, and of course under the jurisprudence of the Alkali Inspectorate. We have felt that it would have been better could we have taken proceedings as a local authority because we know the plant so well, and we also have another metal treatment plant at Kings Norton, which is under the Alkali Inspectorate, where we have problems.

We have asked the Minister if we can have these particular plants within our control, and I believe he is trying to make some decision. We have not had a definite answer yet. I believe it is Manchester, I may be wrong, but I know there is a large authority which has recently had permission to take under its control industries which were considered to be very technical, very difficult, but a local authority can now control them in regard to the Act and the nuisances, etc. We have very good officers, who are very well trained, even though they may make mistakes. We feel sometimes they are not paid a good enough salary because of their high qualifications. They have served for years, many of them, in the well-known services of this country before coming to the local authority and are well-respected and very well-trained, and highly qualified, many of them to inspect this type of plant. Yet we have got the Alkali Inspectorate, with all respect to them.

I believe the time is ripe when the local authorities—the rather large ones who can employ qualified officers, should be able to do this work within their boundaries, going there daily or when they like to talk to the officers inside the works as to what is going on.

Chairman: I believe that Liverpool also have received these powers.

Mr. Dickie: I would like to ask whether in the case just referred to the knowledge which the local authority man has would result in the offence being cured? Or whether it would result in the plant having to be shut down? Would it not be best, if the local authority man has this knowledge which he assumes the Alkali Inspector has not, to go and see the Alkali Inspector, put it before him, who will probably accept it readily. After all, the Alkali Inspector does put his knowledge at the disposal of the local authority in all cases not only in the cases for which he is responsible. And I am certain that all local authority inspectors do appreciate the value of being able to consult them. Surely the reverse could apply in this case?

Speaker from Brighton: I have been wandering around this hall for approximately ten hours and I have not yet heard atmospheric pollution from garden bonfires mentioned. I would like to ask the panel if they have had any dealings with offenders under this particular source of nuisance.

Chairman: Garden bonfires—I must declare my vested interest as a gardener—of course I must tell you that garden bonfires are not in the Act. The Act of course defines smoke emitted from a chimney, and that is one of my get-outs and I am sticking to it. I must say, and I am revealing too much, I do get up quite early on a Sunday morning, at 5.45. I was interested in this when we mentioned soot blowing. Well I get up and light my garden bonfire, I know it produces a lot of smoke, I know there is some awful stuff in that smoke but I am afraid I just do it. It's within the meaning of the Act, but let us have the ' quickies ' from the panel please.

Dr. Parker: I would like to reply to this question from Mr. Guy Fawkes and our all-night Chairman soot blower. There are too many garden bonfires. I have a garden. I admit I do have a fire once a year for hard material; all the soft stuff is properly composted and put back into the ground, there need be very few bonfires at all.

Chairman: I am afraid we shall have to finish because of the trans-atlantic discussion soon, although there are many wishing to speak. This just shows on the point of mistakes—we are all human. Now I well remember a magistrate who was touched to the quick—he asked a prisoner who had been proved guilty had he anything to say before being sentenced, and the prisoner, an ignorant man, very shabbily dressed, who seemed to come from the dregs of society and had committed some awful crimes, won this magistrate's heart. He said: " We are human, aren't we all, My Lord? " And he did very well.

Now to sum up I can see we have got to carry the public opinion with us, and I think the position is very much better and stronger than it used to be. I would think we should meet the industrialist more, he is anxious to help, he is certainly not anxious to be lectured. I think there is a better public spirit nowadays in favour of clean air and I think we should go forward on that, and on that note I would like to finish, and on your behalf should like to thank warmly the members of the panel who have stood up to this barrage of fire, and I think have deserved your thanks.

E. L. Howe (B.P. Research Centre), in a written contribution to the discussion said: One of the questions posed during this session covered possible architectural design development to eliminate or hide tall ugly chimneys. After the conference I recalled a power station which I visited some two years ago which was of unique design and a brief description may be of interest to the Society.

The power station is operated by the Royal Board of Waterfalls at Västerås in Sweden. The layout of the steam generating plant and auxiliary equipment is entirely vertical. The combustion chamber and generator sections are installed on the ground floor. Above this are the superheater sections followed by economisers and air heater section. Above this is the grit arresting and dust removal plant and finally the induced draught fans discharging into a short stack on top of the main building. The total height of the building alone is 60 metres. The height of the chimney above the top of the building is a further 8 metres. Internal lifts are provided to servicing floors built in at strategic heights.

The building housing the plant described above is of quite pleasant external appearance and is certainly not overpowered by a tall stack.

A further written question (sender unnamed) was as follows: I am extending my factory plant and my architect has specified 3 small boilers each with a separate chimney. The local authority has rejected the plans and has specified one chimney only. Have they the power to do this?

The Chairman writes: Mr. Howe's is a most interesting contribution. Much regard would have to be paid to the topography and also the speed and heat of the gases emitted. Few sights give greater pleasure than that of a well-designed building and a graceful and efficient chimney. Sometimes I think we shall have to await the full development of nuclear power before we see an end to the smoke nuisance from old chimneys.

In reply to the written question, the answer is " Yes." Section 10 of the Clean Air Act requires local authorities to reject plans if a chimney is not of sufficient height to prevent a nuisance occurring from smoke, dust, grit, or gas. You must consider the total effluvia from the three furnaces and the effect on the buildings nearto. Regard must be had to position and description of buildings, levels of adjoining ground, and other matters. Obviously the chimneys on the plan are inadequate for the intended purposes.

Mr. Dickie writes: A local authority must reject plans unless satisfied that any emission from chimneys will not be a nuisance or prejudicial to health. In this case it is assumed that the calculations have proved that the stated heights will not satisfy the statutory requirements and the local authority, therefore, not only has the right but is compelled to reject the plans.

The specifying of one chimney only is an attempt to advise the applicant that one chimney discharging the products of three boilers will be more effective from an effluent dispersal angle than three.

Mr. Webber writes: As regards the two unanswered queries, I do not think that a tall chimney need necessarily be ugly. A well-built, well-shaped chimney, if considered dispassionately, is by no means a monstrosity, and indeed, attempts to disguise a chimney by building it into a tower are seldom successful.

As regards the last question, I believe the local authority has power to insist on a single stack, and in my opinion, in general, they are right to do so in view of the much better dispersion then achieved.

Dr. Parker in a written reply to the contribution by Mr. E. L. Howe said that it is possible to build chimneys that are architecturally more pleasing than most of the chimneys that are erected, but at greater cost if they discharge the waste gases at the heights necessary to provide adequate dispersion of the gases. Attractive designs must not be detrimental to dispersion. In the case of the power station in Sweden to which Mr. Howe referred, it is not possible to express an opinion without full knowledge of the amount, composition, velocity and temperature of the gases discharged and of the meteorological, topographical and other local conditions. In most parts of Great Britain, a chimney reaching only about 8 metres above the main building of a power station would not be sufficiently high to avoid periods of serious down-draught.

The further written question submitted raises the point whether or not under Section 10 of the Clean Air Act, 1956 the local authority has power to deal with more than the height of chimneys. This is a point for legal opinion. It should be remembered, however, that in general for a particular discharge the maximum concentration of the discharge will be greater at ground level with three chimneys than with one chimney of the same height. It may be that the architect in the particular instance did not know whereas the local authority did know of this factor.

TRANSATLANTIC DISCUSSION

For this programme a panel of speakers on the platform at Brighton was linked by telephone to members of the Air Pollution Control Association of America, speaking from the Mellon Institute, Pittsburgh. The feature was made possible by the generosity of the Pfizer Group of Companies, to whom thanks are expressed.

The British Team: Sir Hugh Beaver, Chairman; James Goodfellow, Dr. P. J. Lawther, Douglas Lister and Arnold Marsh.

The U.S.A. Team: Dr. E. R. Weidlein, Chairman; Arnold Arch, Dr. W. L. Faith and Dr. R. A. Prindle.

Sir Hugh Beaver: Dr. Weidlein! How are you? I hope you can hear us well. This conference, a thousand strong, of our National Clean Air Society meeting in Brighton sends greetings to you in your new white and gleaming city of Pittsburgh. Here is His Worship the Mayor of Brighton, Councillor G. B. Baldwin.

Mayor Baldwin: Hello, Mr. Mayor. Greetings from Brighton to the city of Pittsburgh. Clean air is of importance to us all and we welcome this opportunity of the Transatlantic discussion. There can be no criticism of the air at this famous seaside resort where we are having brilliant sunshine and a strong sea breeze.

Dr. Weidlein: Hello, Sir Hugh Beaver. I send you greetings from the Society of the Air Pollution Control Association of Pittsburgh and I have the honour to present to you the Honorable Joseph M. Barr, Mayor of Pittsburgh.

Mayor Barr: Mayor Baldwin, I am happy to have this opportunity to greet you and the Convention delegates of the National Society for Clean Air. Here in Pittsburgh we have succeeded in eliminating the smoke and dirt which once went hand in hand with our industrial strength. Once it was demonstrated that smoke control in a steel centre was feasible, Pittsburgh's news forged tools to erase urban blight and decay. We learned to work together, stand boldly and believe our ability to rebuild Pittsburgh into an attractive modern city. I can truthfully say that smoke control has been the cornerstone of our entire rebuilding programme in this city. There is now a brightness in our skies as bright as the attitude of our citizens in helping to bring a pride and spirit to our community. Pittsburgh now stands second only to New York City in the number of redevelopment and renewal projects it has started and completed. In the process we have strengthened our industrial and commercial pace and have expanded and improved all our community facilities. We are happy to share our experiences with you and to pass along any know-how we have acquired within the past 15 years. I hope you will find your smoke control work, the exciting and rewarding adventure it has been to Pittsburgh and its people.

Sir Hugh Beaver: Thank you Mr. Mayor and thank you Dr. Weidlein. I am asking Arnold Marsh, Director of the National Clean Air Society to put the first question.

Mr. Marsh: Hello Pittsburgh. We are very interested in the national goals for air pollution research and prevention published by the U.S. Department of Health. These 10 goals propose a big programme on the effects of pollution, its measurement, control, administration and co-ordination of effort. What we would like to know is whether this programme is generally known and accepted by all concerned, whether it is making good progress and who is responsible for seeing that it does make progress and that it is not forgotten.

Dr. Weidlein: Mr. Arnold Arch, Executive Secretary of the Air Pollution Control Association will be very pleased to answer your question.

Mr. Arch: It's a pleasure to speak with you Mr. Marsh after corresponding with you so frequently by mail. I am looking forward to meeting you to discuss such subjects as our national goal for air pollution control. There is no one way to air pollution control in the States. Each individual community has its own pollution problems and hundreds of local pollution control officials are leading them to individual solutions. Whatever the intensity of the problem, the local official knows co-operation through the community is the key to its solution. APCA brings the best research in all facets of a problem to public attention through its abstracts, its journals and its meetings without identifying the Association with any position or course of action. That is the way it will be until adequate scientific evaluation provides the answer to our Association's satisfaction and, of course, the national goal announced by the U.S. Public Health Service will help our Association immeasurably in following this through. Generally speaking, however, it is an accepted fact that air pollution control is a local problem and although there are many related local problems these programmes must be established at the lowest local level at which the problem exists. Whether it be a city, a county, a group of counties, a small state or an urban area encompassing several states. Since our association is the only one solely devoted to the control of atmosphere pollution in the States I would say that our national goals encompassed the purposes of our Association. By means of our publication and public relations programme the Air Pollution Control Association feels that it is the one organization responsible as a volunteer group for keeping this programme before the public. This leads me to ask your panel how these goals are being tackled in Great Britain.

Sir Hugh Beaver: Thank you very much Mr. Arch. Mr. Goodfellow, Chief Public Health Inspector of the industrial city of Leeds will reply.

Mr. Goodfellow: The Clean Air Act, 1956 gave new legal powers to local authorities in Britain. Five of these are of special interest and in order of importance they are:

1. Power to deal with dark chimney smoke as an offence.
2. The requirement that new furnaces must be capable of burning smokelessly.
3. The requirement of any practicable means for minimising the emission of grit.
4. Control of the height of new chimneys.

and

5. Power for local authorities to declare the whole or any part of the district to be a smoke control area, in which the emission of chimney smoke is an offence.

The Clean Air Act has enabled us to start to tackle the worst part of our atmospheric pollution, namely domestic smoke, and also to deal more effectively with industrial smoke. This work, however, can proceed only at the rate desired by public opinion. Everyone in Britain now wants clean air but the majority only want clean air provided they are not called upon themselves to take any action. We have a long way to go in Britain before everyone sincerely appreciates the value of clean air and willingly adopts methods to reduce and prevent air pollution. Therefore, the National Society for Clean Air which is primarily concerned to promote informed public opinion on the value of clean air has work to do in Britain for many years to come. My question to you is this. What is the U.S. situation on these matters?"

Dr. Weidlein: Thank you Mr. Goodfellow. I will ask Dr. W. L.

Faith, President of the Air Pollution Control Association to answer your question.

Dr. Faith: Mr. Goodfellow, our problem is quite similar to yours in that we also have air pollution from homes, from industries and from motor vehicles. The first real effort in this country to control air pollution was directed towards emissions from homes, particularly those of the inefficient burning of high volatile bituminous in coal hand fired furnaces. Pittsburgh and St. Louis have done remarkable jobs of control in this connection. On the West Coast, however, we do not burn coal and there our home programme is the backyard incinerator, where we burn or did burn until recently, waste paper, rag clippings, and tree trimmings. But this archaic practice is now banned in Los Angeles and San Francisco and will soon be banned in other areas. Our most difficult problem on the home front is perhaps the apartment house incinerator in our large urban centres which are poorly designed and where considerable odour comes from the poor burning of garbage. With respect to industrial concerns we have controls in effect in virtually all communities for the control of dust and fumes and noxious gases. We have many of the same industries as you have, the steel industry, chemical plants, food processing plants, cement mills and others. Our biggest problem is the development of controls which will protect the public and at the same time not put an unnecessary burden, an unnecessary economic burden, on industry. We can't ban an industry like we ban incinerators. One of the Air Pollution Control Association's major activities is the technical, industrial Committee set up where control officials and industrial representatives engaged in co-operative studies to develop reasonable and economic abatement methods. Our most recent efforts of course has been towards the control of motor vehicle exhaust and this is one which is gaining national recognition even though many communities do not have a motor vehicle problem. In some areas, however, particularly California, we have a very acute motor vehicle problem and most of these efforts to develop motor vehicle pollution control devices are taking place there. What is the situation towards pollution from home industry and motor vehicles in Great Britain?

Sir Hugh Beaver: Thank you Dr. Faith, my best regards to you. Mr. Goodfellow will speak again.

Mr. Goodfellow: The primary aim of the Clean Air Act, 1956 was the replacement by smokeless fuels of the 19 million tons of house coal used by domestic consumers in the black areas of Britain. Although a good start has been made, it will take a number of years to complete this task. British industry is taking steps progressively to increase supplies of solid smokeless fuel to meet consumers' demands created by the promotion of domestic smoke control areas. Quite a number of recent local authority housing redevelopment schemes are now using off-peak sub-floor electric heating. More householders in smoke control areas have changed from coal heating to gas or to electricity than was anticipated. But in Britain the need of householders who prefer the open fire will have to be met by solid smokeless fuels for many years to come. I would like to ask you what is the domestic heating situation in America now?

Dr. Weidlein: I will ask Dr. Richard Prindle, Deputy Director of the Division of Air Pollution, U.S. Public Health Service to give you an answer.

Dr. Prindle: Gentlemen, In this country, of course, we have much more central heating than that which is present in your country and I believe that under these circumstances our situation is considerably different, for as Dr. Faith has already mentioned too, our problem is different in regard to the use of fuels in various areas of this country and the heterogenerity of this country makes a considerable difference. We have no national policy in regard to the use of fuels. There is no federal regulation of fuels or air pollution for that matter, as the federal activity is one of research, technical assistance and training as individuals in air pollution matters. The controls are local and under these circumstances vary considerably and rather widely. Dr. Faith has already mentioned that there are such problems as backyard incinerators, which have been banned in his area of California. There, where home heating is primarily a central matter and related to the use of either liquid fuels, gas or electricity, the domestic heating problem is not one of great magnitude.

In the East Coast, there are some problems, particularly in older cities and in older areas where in a few instances central heating does not exist, and in these cases open fires, fireplaces are utilized. This is rather minimal and again depending on our area, our air pollution matters become related then to either industry in certain circumstances or vehicular traffic which has already been mentioned. However, in relation to central heating and the habits of the British in the use of the open fire, we would like to ask the question which has been raised on previous occasions as to the role of central heating versus open fire heating in the causation of, or at least affecting the distribution of, chronic bronchitis in Great Britain. We here have, of course, seen some chronic bronchitis which appears to be less severe and less frequent in the States than in Great Britain. We are concerned with how much of this difference might be a diagnostic difference for we believe there really is a considerable actual difference in the numbers of people affected. We have some suspicions that this might not only be related to the community air pollution problem but frankly to that in the homes resulting from the open fire burning, if I may submit that question.

Sir Hugh Beaver: Thank you Dr. Prindle, Dr. Lawther, Head of the Atmospheric Pollution Research Unit at St. Bartholomews Hospital in London and whom I think you know, will reply.

Dr. Lawther: I'm very glad that you asked me that question Dick, about the chronic bronchitis and the domestic grate because I am quite certain, as you know, that that ought to be our first line of attack. The majority of pollution here to lung level rather than at any other level comes from the domestic grate and as far as our research programme is concerned, it remains our first line of attack. The motor vehicle business of course follows and I think that Mr. Lister is going to tell you about that.

Sir Hugh Beaver: Mr. Lister, County Health Inspector, Northumberland.

Mr. Lister: On the subject of air pollution from road vehicles, here in Great Britain we feel our first priority at this moment is the amount of unnecessary smoke being omitted on the highways, and here by far the commonest offenders are the diesel-powered commercial vehicles of which we have a higher proportion than you have in the States. Now our present law only permits of action by the police in the most flagrant cases and many of these go unchecked, so this Society has formulated a policy statement which it is hoped to lay before the Government and in which there are two main recommendations.

The first is that there should be a considerable expansion of the present system of Government inspection of commercial vehicles, both goods and passenger in order that more attention can be given to the standard of maintenance of engines and fuel systems. The second suggestion is that consideration should be given to getting limits of load for different sizes and types of vehicle to avoid the gross overloading which causes diesel operators to indulge in over-fueling with consequent deterioration in exhaust quality. I think, perhaps, Dr. Faith might like to comment on this, and at the same time give us the latest information regarding motor exhaust pollution in the States.

Dr. Weidlein: Thank you Mr. Lister now I will ask Dr. Faith to reply.

Dr. Faith: Mr. Lister and Dr. Lawther. I might mention, Dr. Lawther, it's good to hear your voice. It has been a couple of years since we saw each other on the same programme in New Orleans.

The motor vehicular pollution control problem in the States has to be attacked in many different ways depending upon the locality. In California of course we are plagued with photo-chemical smog in which case the unburned gasoline and oxides of nitrogen from the exhausts of automobiles react in the atmosphere under the influence of our brilliant sunshine to produce an eye irritant, high ozone concentrations in the atmospheres, typical vegetation damage and a visibility-reducing aerosol. Our attack in this particular case is to prevent the emission of reactive hydro-carbons. There are two sources of these hydrocarbons, crankcase emission and the exhaust itself. We expect to control crankcase emissions by virtue of some type of a blow-by device where we will re-circulate blow-by gases through the engine. The attack on the exhaust will be perhaps actroverters where we will convert the hydrocarbons into carbon dioxide and water. Now there are, of course, many areas in this country which do not have photo-chemical air pollution. There, however, the problem may be high carbon monoxide concentrations. Again actroverters should do the job. There is also the suspicion that exhaust smoke may contain carcinogens and we need to know a great deal more about this. Now diesel smoke over here is an entirely different matter. Actroverters will not do the job. I like, however, the policy which has been outlined by the National Society for Clean Air and I particularly like that portion dealing with the underrating of engines to prevent over-loading. I think this is a very reasonable way of approaching that problem.

Sir Hugh Beaver: Thank you Dr Faith. I am afraid we are outrunning time a little bit and I wonder if both sides can curtail their answers over the next eight minutes. Dr. Lawther.

Dr. Lawther: I'd like to ask the question—as we all know the industrial exposure to all sorts of pollutants is unofficially limited in both our countries by the table of maximum allowable concentrations which were agreed and recommended by your conference of Governmental Hygienists. Now these M.A.C.s as they are called are supposed to be safe by a very wide margin for fit men working in them for about eight hours a day but obviously in the community both here and there we are concerned with some pretty frail people who are obliged to carry on breathing for 24 hours. Now I know you have worked out some very sensible community M.A.C's in California and Riazenov in the U.S.S.R. has proposed some very low ones for many other urban pollutants. Are you going to apply similar values or do you think their use is practicable in say planning and siting new industry and housing?

Dr. Weidlein: Dr. Prindle.

Dr. Prindle: Ah Pat, it's good to hear you again and my best regards to you. In regard to your question, the California standards that were established, as you can see, are somewhat different from those established by the Conference of Governmental and Industrial Hygienists, and we follow the same precepts which you have outlined. That is, that the community air requires perhaps greater safety than that found in industry. Not only are the people exposed or perhaps not as healthy as the average worker and in different age groups, but they are exposed for longer periods of time day in and day out. There are other areas of the U.S. considering such standards, there are also several areas of the States in which standards are being established at the local or state level in regard to the location of industry. At the present time, however, there is no wide move to establish these on a nation wide basis as Ampion standards. In regard to the Russian experience or at least the standards which they state they are utilizing, they are extremely low by most of our accepted techniques. However, using certain biological indicators recently in some studies, we have found effects in both people and animals at levels consistent with those the Russians have established. Therefore, we are beginning to re-examine our position and at this time it will be premature to state any specific standard as one that we would wish to adopt. I wonder, in regard to the establishing of standards, what techniques and approaches you have taken toward the establishment of standardized measurement since this, of course, is a major problem in attempting to study standards, is establishing something that can be measured.

Sir Hugh Beaver: Mr. Lister.

Mr. Lister: Many local authorities in this country have for very many years been making independent measurements of air pollution in their own areas including such matters as smoke, sulphur and dust fall. More recently it has been felt that these observations could be more valuable if planned on a national basis and so our Government's Department of Scientific and Industrial Research has now produced a scheme whereby about 120 selected towns covering a wide range of degree of pollution and weighted for population will furnish information collected using standard methods on two counts. First the smoke concentration measured by a daily smoke filter and, second, sulphur dioxide measured by the hydrogen peroxide method. These selected towns will then show a national pattern of pollution against which all authorities will then be able to measure the size of their own problem. As to the financing of this problem, the instruments and their maintenance are paid for by the individual local authorities whilst the Department of Scientific and Industrial Research is, of course, Government sponsored, although the local authorities are encouraged to and many do make voluntary contributions to the Department for its central co-ordinating services. Now I know that our Mr. Marsh on this side is also anxious to say something about this matter of finance.

Sir Hugh Beaver: Mr. Marsh.

Mr. Marsh: Just one point on finance. We have noted, not without envy, the success of your Association in interesting industry in its work and receiving generous support from industry to your funds. We in Britain have much more moral support from industry than we had in the past but not very much in the way of financial help. Can you give us any hints, and is it a fact that your industry is more conscious of the importance of the public relations aspects of helping the drive for clean air?

Dr. Weidlein: Mr. Arch.

Mr. Arch: I can assure you from my own personal experience as a former Control official co-operating very closely with industry, that the matter of unusual budgets is not true in every instance in this country. The figure of $4 million for Los Angeles county is equal pretty nearly to the sum of all the rest of the several hundred local agencies administering air pollution control legislation all over the States. We have been fortunate in gaining considerable industry support through the years because we are the foremost group in this country, consequently industry has found it most advantageous to discuss common problems with the various interests in our annual meetings and through the medium of our publications. On the subject of international co-operation, I might say that our Board of Directors has promulgated a policy of encouraging the formation of an international federation on air pollution. By meetings of this type that we are conducting today we hope to continue and eventually culminate in an international conference. May I ask this time what your experience has been along these lines?

Sir Hugh Beaver: Mr. Marsh.

Mr. Marsh: As you know, especially Mr. Arch, we are very anxious to promote international co-operation and our recent international conference was a step in that direction. But again our paucity of funds is a difficulty but we are only too glad, even now, to co-operate with you as far as we can and especially in the exchange of literature and information and keeping each other informed over the whole field.

Sir Hugh Beaver: Dr. Lawther.

Dr. Lawther: It seems to me that the most important object of our collaboration in this field is to make careful comparison with the nature and the amount of pollution in our various towns and then to link these with the comparisons of illness. The enormous differences between our two peoples in respect of bronchitis that Dr. Prindle has mentioned, have got to be looked at to see if they are real or not and if they are real, they may be due to differences in the pollution and it is, therefore, important to compare and contrast all these figures and I think it is this sort of international collaboration and the interchange of reputable and experienced workers in this field that will bear far more fruit than many of the big shining bits of apparatus we all have.

Sir Hugh Beaver: Well that closes this transatlantic link up. It has, I think, struck a special and important note in our conference. As Chairman on this side, I would thank all who have taken part and in particular I would like to thank you Dr. Weidlein my old friend, and your team. I will not attempt to sum up myself now. I would only endorse as strongly as I can what has just been said as to the great opportunity there is for international co-operation. To distribute our information as we get it to one another, our experience and to avoid waste of time and money in duplicated research. Thank you very much and all good wishes.

Dr. Weidlein: Thank you Sir Hugh Beaver. It is 33 years to the day since you visited Pittsburgh and I first made your acquaintance. We have made tremendous progress in our city since your visit and I want to say today we have got a beautiful sunshine day whic have got a beautiful sunshine day which is typical of the atmosphere of the present time. We have enjoyed our visit to you and I am sure will benefit from the exchange of ideas. However, with all of the scientific research and engineering progress that has been made over the last several years, progress would not have advanced to the present state without the backing of an enlightened public and enlightened public officials. I hope this programme will further enlist their support. The team approach to air pollution problems in this country is stressed by the air pollution control association and I thank you for having taken part and again for being in contact with you.

Sir Hugh Beaver: Thank you all very much.

WHOLE-HOUSE HEATING SYSTEMS

by W. F. B. Shaw, B.A.[*]

INTRODUCTION

IT is common ground that the standards of domestic heating in this country have tended to be deplorably low. Our temperate climate, which has allowed us to legislate for the average and endure the worst, and our adherence to the traditional open coal fire, founded upon a Victorian abundance of cheap coal and domestic labour, are the factors which are probably mainly responsible for bringing about this position. Up to the time of the Second World War it was the normal domestic practice to heat individual rooms, and often one room only, while the rest of the house was heated little or not at all.

Since the war, however, there have been clear signs of improved comfort standards, an increasing awareness that these are obtainable at much less cost than it has been customary to believe, and an increasing willingness to devote some of the benefits of today's higher standard of living to this particular end. Even so, domestic heating equipment still seems to rank quite low in priority, in many household budgets, in comparison with such other needs as television sets, washing machines, refrigerators and motor cars.

It is now generally agreed that for some capital cost, but for a comparatively small increase in running cost, we can change from heating only one room to heating all, or substantially all, of the house. If we make this change we shall create not only a much greater area of comfort within the home but also, in general, a higher level of comfort. Moreover, the capital expenditure will not only have bought the equipment for the central heating installation, it will also have purchased considerable increases in convenience and cleanliness and a reduction in the time and effort spent in handling fuels and ashes.

From the point of view of the National Society for Clean Air, whole-house heating has the pre-eminent advantage that all the methods used for it are, by and large, smokeless. A continuance of the present trend towards this form of heating is therefore to be encouraged for the benefit not only of the individual but of the community as a whole. All the main fuels available in this country—solid smokeless fuels (both natural and manufactured), town gas, electricity and oil—have their contribution to make.

It is obvious that the spatial limitations of a paper such as this will permit only a very restricted treatment of a subject so broad as whole-house heating. The paper is primarily concerned with the systems and equipment which are suitable for the heating of family houses. Much of this is, of course, also appropriate to the heating of bigger buildings such as blocks of flats, but the special features which distinguish the larger problem are not dealt with. On the other hand the term " whole-house " has not been applied too rigorously, and systems which are designed for the heating of sections of a house (generally referred to as " partial " central heating), have been included. The greater part of the space has been devoted to the description of the characteristics and capabilities of the different combinations of fuel and equipment which are available at the present time, since it is with these that the householder is mainly concerned and it is to the householder that the paper is principally addressed. Firstly, then, there is a section describing the different ways in which heat can be distributed around the house and then disseminated in the individual rooms. There follow brief passages dealing with economic factors, and with some of the more important design considerations.

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Finally come the four main sections dealing, in turn, with the various heating appliances grouped according to the fuel they use.

CENTRAL HEATING SYSTEMS

There are three main ways in which heat produced by some central source can be distributed throughout a house. They are:

1. Distribution in the form of hot water,
2. Distribution in the form of warm air,
3. Underfloor electrical heating.

The third of these represents rather a special case and is dealt with later, in the section concerned with electrical methods of heating. The other two are now discussed in turn.

Hot Water Systems

Here again two types of system may be recognized. In the past it was normal practice to use the *gravity system,* in which the circulation induced by normal gravity effects is relied upon to drive the hot water around the pipes. For this to be effective it is necessary to use 1-in., 1¼-in., or even larger, piping and generally to take care to minimize pipe frictional losses. In recent years, however, silent and compact types of glandless electrical circulating pumps have become available. These have permitted the development by the British Coal Utilization Research Association of the *small-pipe forced-circulation system* of central heating which is being increasingly used in domestic applications. With pump circulation, copper pipes of ½-in. nominal bore, or ⅜-in. black iron pipes, are quite adequate for most household circuits. The uncontrolled heat losses from the exposed piping are lower, and the flexibility of the whole system greater, than for conventional large pipe installations. In addition, the small pipes can be run neatly and unobtrusively round skirting boards and doors, with a minimum of damage to decorations, so that the small-pipe system is particularly suitable when an existing house is being converted to central heating.

Whichever method is selected for the conveyance of the hot water from the central appliance, there is then a variety of ways in which the heat can be released in the rooms themselves. The most usual method is by some form of *radiator.* (It may be noted that the word " radiator " is somewhat of a misnomer in this context, since the greater part of the output is in the form of convection from the heating of the air adjacent to the radiator surfaces.) There are various types such as the *multi-column cast-iron radiator*, the *hospital type radiator* which is designed to facilitate cleaning, and the *wall or panel radiator*. In some circumstances an *encased radiator* or *encased convector* may prove advantageous; in these the casing induces a flow of air past the radiator itself, thus increasing the emission from the heating surfaces.

It is generally preferable, from the point of view of comfort, to install the chosen type of radiator under the windows rather than on inside walls, since in this position it tends both to neutralize the cold down-draughts which would otherwise be set up by the windows, and to reduce " convection staining ", the deposition of dust particles on the wall above a radiator. Again, it is preferable to have a radiator which extends practically to floor level and thus promotes some warm-air circulation at low levels.

The heat input to the room can be distributed still more widely and uniformly if low-level radiators are installed throughout the length of the outside walls, and not restricted to the area under the windows. Special *skirting heaters* have been developed for this purpose. In their simplest form they consist of a rectangular section metal skirting, 6 in. to 9 in. high, through which the hot water is passed. Where it is necessary to provide a greater heat emission per foot run than can be given by this arrangement a *skirting convector* can be used; here the skirting tube is either finned on its back plate or gilled and enclosed within an outer casing which is slotted to promote the through flow of air.

Floor heating can be obtained by using steel or copper hot-water pipes spaced at about 6-in. intervals at a depth of 2 in. to 2½ in. below the surface of a solid floor. This form of heating is generally very effective as regards comfort, since it gives better conditions of temperature gradient than do systems where the heating is peripheral, while it also tends to reduce floor draughts. It is regarded as particularly suitable for use in open-plan types of housing. Floor heating is referred to again in the particular context of off-peak electrical heating, where the necessary precautions with regard to maximum floor temperature and to underfloor insulation are outlined.

Embedded ceiling panels also provide a possible method of heat distribution, though they have not yet been used extensively in private dwellings. The limit to comfort with such installations is set by the intensity of radiation at head level.

Warm Air Heating

Two distinct types of warm air heater may be recognized. In the first the starting point is a supply of hot water, derived from any of the forms of boiler described later in this paper. This hot water is passed through a finned heat exchanger over which air is blown. This yields a supply of warm air which is then either ducted to the various outlet points in the rooms or discharged at some central point in the house. The heat exchanger need not be adjacent to the boiler itself but may be sited at the point in the house best suited to the subsequent distribution of the warm air. In fact, it is general practice with all types of ducted warm air systems to have the source of warm air at a central point and to run the ducts, and site the outlet points, on inside walls.

Alternatively the warm air may be directly produced in some form of furnace without the intermediary of hot water. Heating units of this type are available for all fuels and are described in the appropriate sections of the paper.

ECONOMIC FACTORS

Two factors which are of major importance when a heating system is under consideration are the capital cost and the running costs. It is unfortunate that truly comparative information on these subjects is very scanty, though it is not hard to see why this is the case.

As far as capital costs are concerned, existing and new houses represent quite distinctive cases. The cost of converting an existing house will depend very much upon its layout and upon a host of individual considerations. In the case of a new house, on the other hand, the house, its heating system and the fuel storage (where required) can and should be planned as an integral unit; savings in construction may then be possible with some systems, though not with others, and these should be credited to the overall costs. In both existing and new houses account must be taken not only of the equipment itself but of the constructional and other builder's work necessary; labour charges vary from time to time and place to place, and can account for a sizeable proportion of the whole cost.

Then, as regards running costs, it must be recognized that houses differ very much in size, insulation and exposure. Families vary in size, living habits and economic circumstances. Heating systems differ to some extent in degree of controllability.

Capital Costs

Building Research Station Digest No. 93, " A Comparison of Capital Costs of Heating Systems in Houses ", obtainable from H.M. Stationery Office, gives a number of useful facts and figures in relation to the equipment of a new small semi-detached house of 900 sq. ft. area, both for central heating and for conventional heating systems using local appliances. The costs quoted are based on the rates and prices of the winter of 1955-56; to convert them to current conditions it is necessary to add something of the order of 12 to 15 per cent.

The figures given for whole-house heating installations, which include provision for domestic hot water, may be summarized as follows:

System	*Fuel*	*Cost*
Hot water	Solid fuel	£360 to £465
do	Oil	£525 to £630
Ducted warm air	Solid fuel	£420
do	Oil	£555
do	Gas	£425
Electrical floor warming	Electricity	£300

Six different hot water systems are quoted for; this accounts for the range of prices. The original Digest should be consulted for details of the basis on which these costs were prepared.

No cost is given for a hot-water radiator system supplied from a gas-fired boiler, but, from the figures quoted for the ducted warm-air systems, it seems probable that it would be only slightly greater than that for the corresponding solid-fuel-fired system.

In considering these costs in relation to the equipment of a new house it must be reckoned that, if central heating were not installed, it would then be necessary to allow for a conventional installation involving some kind of solid-fuel fire in the living room, winter hot water either from this appliance or from an independent boiler, an alternative source of summer hot water, and bedroom heating by electric fire, gas fire or radiator. Digest No. 93 gives estimates for a number of different conventional systems conforming to this general specification, quoting costs between £167 and £268, and a sum within this range must be subtracted from the costs listed in the Table below to give the *extra* cost of installing central heating in a new house.

The figures which have just been cited relate to a particular design of new small house. Nevertheless they are of some value in indicating the general orders of magnitude involved and, perhaps more particularly, in showing the extent to which the choice of fuel affects the capital cost. In view of what has been said earlier, it should not be assumed that the figures will apply in the case of the conversion of an existing house to central heating.

Running Costs

During the last few years estimates have been published in various places, and by various organizations, of the relative running costs of central-heating systems fired with solid fuel, oil and gas. These estimates have depended upon a knowledge of the thermal efficiency of the hot-water boiler, and upon the reasonable assumption that, from whatever source the heat is derived, the same amount of it will be needed (and will be used) in each case. They have, however, aroused considerable controversy owing to divergencies of opinion as to the appropriate values of efficiency to use for the calculations. It seems undesirable to enter into this controversy here, and it will be sufficient for present purposes to conclude that:

1. Gas is a markedly more expensive fuel than either solid fuel or oil.
2. The difference in running cost between solid fuel and oil is comparatively small, oil being somewhat the more expensive on current London prices.

If electrical floor warming is costed by the same procedure, using an approximate efficiency figure quoted by the Building Research Station in Digest No. 133, it is concluded that it is more expensive, for the supply of equal amounts of heat, than gas-fired central heating.

SOME DESIGN CONSIDERATIONS

A number of factors, of varying degrees of importance, have to be taken into account when choosing a central heating system. Among these the following may be particularly noted:

1. It must be decided whether heating is to be provided throughout the house or only in selected parts of it.
2. There is the question of the standard of heating to be adopted in different rooms. For full comfort level it is necessary to design for the maintenance of an air temperature of 65° to 68°F. Alternatively, it is possible to provide " background " heating to a lower level of temperature, with the intention of " topping-up " to full comfort level, when required, by means of local radiant appliances.
3. Is the house concerned new or an existing one? The conversion of an existing house will always impose a number of limitations on what can be done. For example, all types of ducted warm-air system, other than those where only adjacent rooms are catered for, are effectively precluded. There may also be problems in finding a suitable space for fuel storage. With a new house, on the other hand, it is possible to consider all the available systems and to achieve the ideal, the design of house, heating system and fuel storage as one unit.
4. The availability of fuels must be considered, since there are some local limitations. Some rural areas do not have supplies of gas. Gravity-feed boilers require special sizes and types of anthracite, and it must be established that these are readily available.
5. What, if any, alternative sources of heating are to be provided to meet short-term demands during spring and autumn?
6. It must be decided whether an independent source of water heating is to be provided for use in the summer months. This will depend to a considerable extent on what decision has been taken under item 5.

In large measure the final choice will be dependent upon both personal preferences and on economics. Once the heating system and fuel have been selected it is primarily a matter for the expert heating engineer to do the planning. Firstly, the heat losses of the house must be calculated from a knowledge of its size, construction and exposure. It cannot be too strongly stressed that with central heating systems the insulation of the dwelling must be as high as possible, and the ventilation be controllable, if excessive and unnecessary heat wastage is to be avoided. The heat losses, with a suitable margin to allow for unusually cold spells, establish the right size for the boiler or other ultimate source of heat; if the same system is to provide both heating and the domestic hot water an appropriate addition must be made for the latter. The heat loss figures also show the heat requirements of the individual rooms and so enable the correct sizes of the various radiators, etc., to be calculated.

It is the engineer's responsibility to see to a number of other things. He must ensure, for example, that the pipe runs are planned for maximum economy and effectiveness, and in such a way as to avoid air-locks. The whole system must be capable of being drained, and an expansion tank must be provided above the level of the highest radiator. The radiators or other local sources of heat must be installed at the most effective points in the rooms. Where the same boiler provides both space and water heating it must be ensured that there are no undesirable interactions between the two parts of the system. Where ducted warm-air systems are used the inlet and outlet grilles must be correctly dimensioned and positioned to suit the rooms in which they are installed.

SYSTEMS USING SOLID FUELS

Various solid fuels have been declared as authorized fuels by orders made under the Clean Air Act, 1956. They can be divided into four groups or types:

1. The natural smokeless fuels—anthracite and dry steam coals.
2. " Phurnacite ", a carbonized ovoid manufactured from natural smokeless fuel.
3. Gas cokes, and hard or oven cokes, the latter group including " Warmco " and " Sunbrite ".
4. The more reactive manufactured fuels, including " Coalite ", " Rexco ", " Cleanglow " and " Phimax ".

Some of the cokes in the third of these groups are produced to conform with the quality requirements of B.S. Specification 3142 Pt. 1 (" Cokes for Domestic Open Fires ") and are marketed under brand names such as " Gloco " and " Sebrite ".

For central heating applications the main load is taken by the fuels in the first three of the above groups, the more reactive fuels of the fourth group being normally used in open-fire types of appliance. Most of the fuels are available in different size gradings, chosen to suit particular types and sizes of appliance.

There are four main types of solid-fuel appliance which are used to supply hot water for central heating purposes, the sectional boiler, the gravity-feed boiler, the pot-type boiler and the open fire with high-output back boiler. Broadly speaking, the first two of these are suitable for the larger installation, the third is appropriate for the smaller house, while the fourth is intended for quite limited applications.

In addition, there are several types of unit which are designed to supply warm air, for both ducted and unducted systems of heating.

Sectional Boilers

The sectional boiler is the traditional type of appliance used for domestic central heating. It derives its name from the fact that it is built up of cast-iron sections bolted together, the number of sections used being determined by the output required. This is a method of construction which enables the manufacturer to offer boilers with a wide range of output (commonly in steps of 10,000 to 15,000 B.t.u./h.) from about 30,000 B.t.u./h. upwards, in an economical manner.

Except, perhaps, for the largest sizes, boilers of this type can be installed in the kitchen and are now available in attractive stylings, with vitreous-enamelled casings. They are most usually operated on gas coke or hard coke, hand fired. The ash removal facilities are good. A thermostatic control is fitted which, in its modern form, gives a reliable and sensitive control of the water temperature.

Gravity-feed Boilers

The gravity-feed boiler (see Fig. 1) is designed to minimize the attention which it needs from the householder, and has a hopper which holds enough fuel for at least 24 hours operation in the coldest weather. This means that in the milder periods the boiler can run from two to three days without attention, while in summer, when used for domestic hot water supply only, unattended runs of up to a week may be possible. As the fuel burns away more is fed to the fire, by gravity, from the hopper. The combustion air supply, sometimes derived by natural

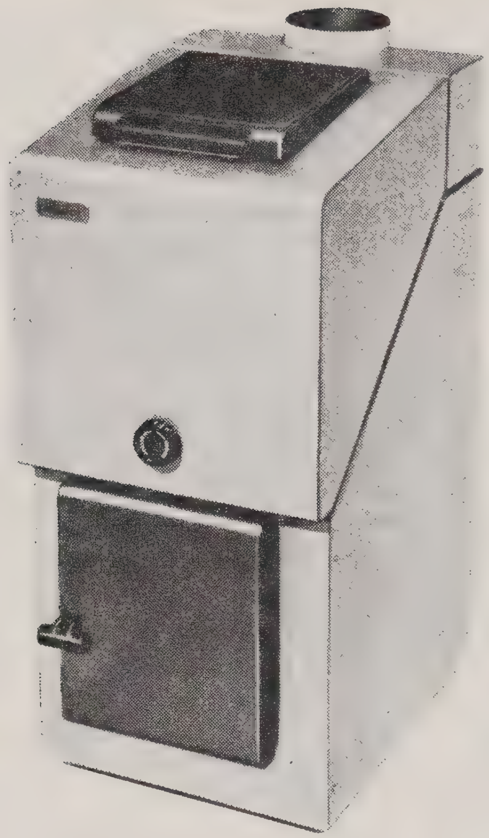

Fig. 1. Gravity-feed boiler (Janitor Boilers Ltd.)

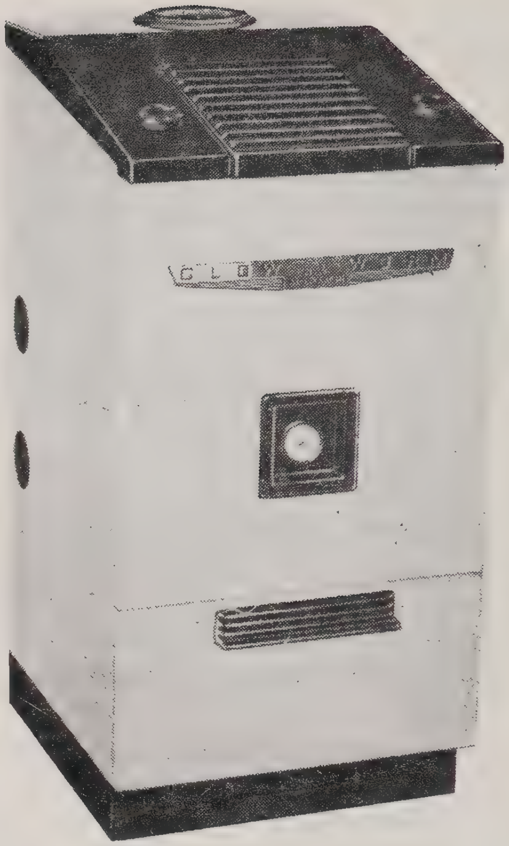

Fig. 2. Independent boiler, with thermostat (Glow-worm Boilers Ltd.)

draught but more commonly forced by a small electric fan, is designed to yield a small but intense fire. This leads to a clinkering of the ash in the fuel, and the solid " clinker pad " is easily removed when the appliance is tended.

The fuel used is normally small-graded anthracite, in bean, pea or grain size. Small coke may be used in some of the larger models. The basic features of gravity-feed boiler design, however, make it imperative that each model should always be used with the particular type and size of fuel recommended by the maker. Models are available in a variety of sizes from about 35,000 B.t.u./h. upwards.

Pot-type Boilers

The pot-type boiler is a somewhat smaller type, covering the range of outputs up to 30,000 B.t.u./h. (at the rating of 6,000 B.t.u./h. per square foot of heating surface), with one exception which has a rating of 50,000 B.t.u./h. It consists essentially of an annulus of square, circular or horseshoe form, the inside space forming the fuel pot. A shaking grate is normally fitted to facilitate ash clearance, and a vitreous-enamelled casing gives a clean and smart external appearance (see Fig. 2). While some designs are available without thermostat the great advantages which this device confers, in reducing attention and in providing automatic control, make it a very desirable adjunct. This type of boiler operates on any type of smokeless fuel.

Open Fire with High-output Back Boiler

This is the smallest of the solid-fuel appliances which can be used for central heating. It comprises an open fire of normal modern type, with controlled combustion air, but fitted with a boiler which is specially designed to give an abnormally high output. The boiler is either unusually large or, in some cases, has its output increased by " finning " or by construction in tubular form. Fires of this type are normally rated as able to supply 80 sq. ft. of radiator surface if used for space heating only, or half this amount if also required to provide domestic hot water. Thermostatic control of the boiler output is, of course, not possible.

Whole-house Warming Unit

This is a unit designed to supply warm air to a ducted system. It consists basically of a furnace which burns in the down-draught mode, with controlled primary and secondary air supplies. The hot combustion gases circulate in a three-pass heat exchanger through which air is blown by an electrically-driven fan, heated and then passed to the distribution ducts. The unit also incorporates a hot-water cylinder, to supply domestic needs, which is heated partly by radiation from the furnace and partly by the surrounding warm air; a gas circulator is fitted to provide an alternative summer source. The whole unit is enclosed in a cabinet which is installed in a recess, often in the kitchen. A suitably-placed room thermostat controls the operation of the warm-air circulating fan, switching it off when desired temperature is reached. A second, preset, thermostat operating at a selected point within the main cabinet controls the supplies of combustion air to the furnace, so regulating the rate of burning of the fuel.

The unit will burn any type of smokeless fuel. As a result of its particular form of design it will also burn bituminous coal with so little emission of smoke that it has been approved under the provisions of the Clean Air Act for use in smoke control areas. It is suitable for the heating of houses of up to 1,500 sq. ft. area. The same manufacturers also market versions of this unit for gas and for oil.

SYSTEMS USING GAS

Gas, or more correctly " town gas " to distinguish it from the bottled variety, is available as a piped service over much of the country. As supplied it is measured by volume but charged by its heat content (in therms), the supplying authority being under a statutory obligation to maintain the calorific value at a declared level. It is manufactured in a variety of types of plant from both coal and oil, and is also obtained as natural gas from various sources. In consequence it is normally distributed as a blend, balanced to have the right combustion characteristics. This involves the use of a second control, which takes into account both calorific value and density and is known as the " Wobbe Index ". This index varies in different parts of the country.

The domestic consumer normally has the choice of two tariffs, a flat rate and a two- (or three-) part tariff. The latter will always prove advantageous when gas is used on the scale required for central-heating purposes. The price of gas varies considerably from one part of the country to another.

Gas may be used as the fuel for the supply of whole-house heating systems either by the circulation of hot water, derived from boilers or circulators, or by means of warm air, in both ducted and unducted systems.

Boilers

Self-contained gas-fired boilers are available in a wide range of outputs to cover all normal domestic requirements. Full thermostatic and time-switch controls are readily applicable to them, giving a high degree of flexibility. Modern gas boilers are silent in operation when properly adjusted, and occupy somewhat less space than solid-fuel or oil-fired boilers of equivalent output. Many models are styled in a form which makes them suitable for installation in the kitchen (see Fig. 3). However, since they do not require fuel storage facilities nor a long flue they are not limited to ground floor use and can, if desired, be installed on an upper floor or even in the roof space.

Gas-fired boilers do not require chimney draught to ensure an adequate

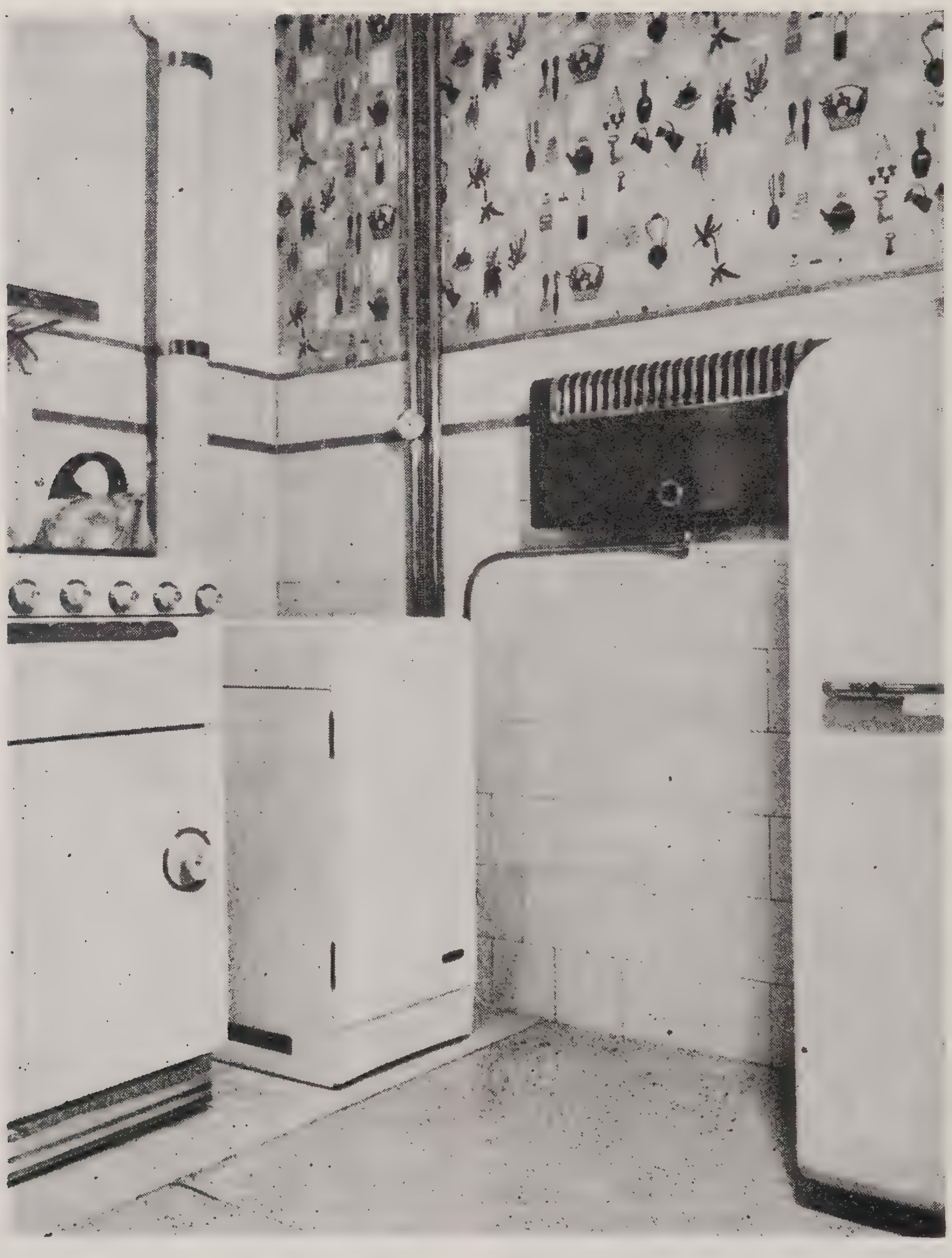

Fig. 3. Gas-fired boiler, in corner next to gas stove (Potterton Division, Thos. De La Rue and Co. Ltd.)

supply of combustion air; the only purpose of the flue is to carry the products of combustion away to the outside air. A baffle and a spoil-draught must, however, be provided immediately above the boiler to prevent back-draught and to minimize the dangers of condensation in the flue. All types are fitted with safety devices to cut off the gas supply in the event of failure of the flame or of the electricity supply.

Gas Circulators

The gas circulator is a water-heating device primarily designed for inclusion in a hot-water system, where it is used either as a " booster " to the heating appliance which it supplements or as an alternative source in summer.

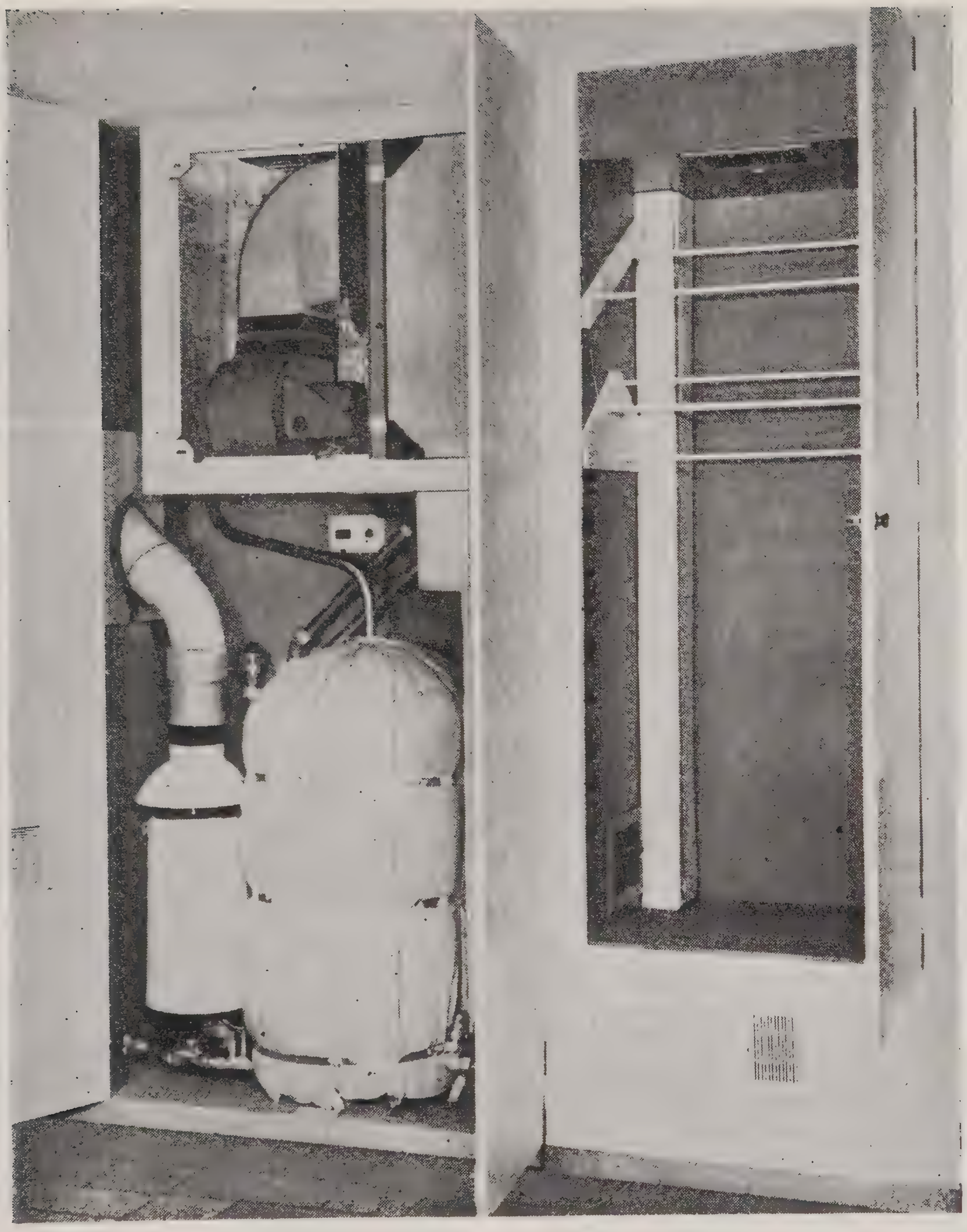

Fig. 4. Above: Air heater with forced circulation. Below: Gas water circulator (Radiation Group Sales Ltd.)

Circulators are, however, available in a variety of sizes and the larger ones may be used instead of boilers to supply central-heating systems (see Fig. 4).

Warm-air Heating Units

Two main types of gas-fired warm-air heater may be recognized, the "*selective*" and the *whole-house*, though the distinction between them is not entirely clear-cut, the smaller types of whole-house unit being suitable also for selective purposes. The former of these (see Fig. 4) is used in suitably-planned houses to supply heat to two or three adjacent rooms or spaces, such as the hall, the sitting-room and the dining-room. With the outputs available (about 18,000 to

26,000 B.t.u./h.) these units will either give warmth to background level in all three rooms at once or, by the use of adjustable registers, may be made to give full heating in one of the rooms at the expense of a reduced level of temperature elsewhere. This selective method of operation offers a rapid heating rate, when a single room is required to be heated, without the greater capital and running costs of a larger installation. Some of the smaller models are available in three forms, for use with conventional flues, balanced flues and Se-ducts; the second and third of these are particularly suitable for use in tall buildings.

The whole-house warm-air units are intended for the ducted heating of the whole of a house. They are therefore of greater output than the selective types, ranging from 35,000 up to about 75,000 B.t.u./h., while they incorporate a more powerful air circulation fan to overcome duct resistances while maintaining realistic room discharge temperatures.

All types of warm-air heater have the usual flame-failure and other safety devices, and are suitable for the application of both time-switch and thermostatic controls. Some are provided with electric ignition, a useful feature allowing, for example, attic installation in bungalows. Some units are available which incorporate both an air heater and a domestic water heater in a " packaged " form, but generally the practice is to keep these separate.

It is expected that, in the near future, gas-fired warm-air heaters of U.S. and Canadian origin will be available in this country. These will generally use the " perimeter " system of distribution which is common practice in North America. In this the heated air is distributed through radial feeder ducts and discharged into the rooms at floor or skirting board registers on the outer walls.

SYSTEMS USING ELECTRICITY

Electricity is now available over a large proportion of the country, including rural areas. It is generated mainly in coal-burning stations, with oil, water power and nuclear energy playing relatively small parts at the present time. A " grid " system of interconnection provides for the supply of power from one district to another, so that the whole system is flexible in its ability to meet sudden local demands.

Electrical energy is measured and sold in kilowatt-hours, commonly referred to as " units ". For domestic purposes the householder usually has the choice between a flat rate and either a two- (or three-) part tariff or a two- (or three-) block tariff. In practice the flat rate will only be economically advantageous where the usage is quite exceptionally low.

Today all Area Boards offer energy at specially cheap rates during " off-peak " periods when demand on the system is at a minimum. These off-peak periods may vary slightly from area to area but usually cover a period of 12 hours in the evening and night, and a period around midday, with longer periods at the week-end. Storage space heating and water heating systems enable advantage to be taken of these cheap tariffs.

Electrical central heating can be effected by means of a conventional hot-water radiator system, the hot water being supplied either from an electrode-boiler or by an immersion heater circulator. An alternative which takes advantage of the off-peak tariff is to heat water during off-peak periods by one of the methods just quoted and store it in a vessel from which it is supplied to the radiators as required. Space must however be found for the storage vessel which, at the present time is a fairly expensive piece of equipment, so that this system of heating is not really practicable except in the larger premises.

Underfloor Warming

The main method of electrical whole-house heating at the present time is that of underfloor warming, and it is on this system that attention will be concentrated. Electrically-warmed floors can be designed to operate either as " storage " or as " direct " systems. In storage systems the basic arrangement is that electrical heating cables are buried from 2 in. to 3 in. below the surface of a concrete or similar floor of high thermal capacity, and it is this floor which forms the main heat storage medium. Electrical energy supplied to the floor is stored there as heat, in sufficient quantities to maintain the desired temperature conditions in the room for long periods.

There are two generic types of installation, the *embedded* and the *withdrawable*. In the former of these the heating cables are actually cast solidly into the concrete screed which forms the upper part of the floor. A number of special cables have been developed for this purpose, the majority being insulated with plastics such as nylon, p.v.c. and neoprene. In the latter type small ducts are laid or formed in the floor, with connecting loops and access troughs, the heating cables being installed in the ducts after the building work has been completed.

Embedded systems are much the cheaper to install, being only one-third to one-half of the cost of the withdrawable type. They are nevertheless entirely reliable and are used almost universally for domestic installations.

With either system of installation any normal form of floor finish can be applied to the surface of the concrete. Wood blocks, plastic tiles, cork tiles and carpets are all used satisfactorily, but it is important to see that the concrete is completely dry before any finish is applied. On ground floors it is desirable that thermal insulation should be applied to the perimeter of the warmed floor, where it meets the external walls, in order to minimize the loss of heat to outside. Suitable materials for this purpose are resin-bonded glass-fibre, mineral wool, expanded polystyrene, expanded rubber, and cork, with a minimum thickness of 1 in. in all cases. Where the site is known to be wet, or in small buildings where insulated floor coverings such as carpets will be used, it will be desirable to extend the horizontal part of this insulation under the whole of the floor. Care must then be taken to ensure that the selected insulating material has sufficient rigidity to withstand the load above it without appreciable compression; the soft quilts used for sound insulation are quite unsuitable. It is also important that this insulating material, and the portion of the floor above it, cannot become damp due to rising moisture from the ground, especially in summer when the heating installation is not in use.

There is a limit to the temperature to which the floor surface can be raised without discomfort to the occupants of the house, and this is of the order of 75° to 80°F. This temperature limit means that the amount of heat which can be transmitted from the surface of a warmed floor is also limited. The maximum rate of transmission is found to be adequate in the majority of cases. Where it is not, it is necessary to supply the balance of heat from some other source, such as a radiant fire.

On-peak Floor Warming

It is clear from the foregoing description that off-peak electrically-warmed floors find their main application in new dwellings. Methods of floor warming suitable for " direct " or on-peak operation have also been designed, and these can usually be installed in existing premises. The simplest arrangement for this purpose is the warmed carpet underlay, which has heating cables woven into its structure. This can be used either between a carpet and its existing underfelt, or in place of the normal underfelt. It is provided with a flexible cord at one corner for connection to a convenient socket outlet. The control may be either by manual switching or by means of a special plug incorporating a temperature controller.

An alternative arrangement can be provided over existing floors by laying strips of hardboard, 3 in. to 4 in. wide, over the floor surface, leaving about $\frac{1}{4}$ in. between the strips. Heating cable is laid back and forth in the grooves so formed, and the whole covered by sheets of hardboard to which any desired finish can be applied.

Recently special domestic thermal storage heaters have been introduced which enable thermal storage central heating to be undertaken in existing premises. Appliances for both " continuous " and " intermittent " heating are available that are attractive in appearance and enable the occupants of old dwellings to enjoy the advantages of off-peak central heating.

SYSTEMS USING OIL

Oils used for domestic heating purposes are distillates, that is, they are produced from crude petroleum oils by distillation, in the course of which fractions of different boiling-point range are separated. Two grades are sold, often under proprietary names, for use in the types of burners used in boilers and warm-air heaters; the lighter grade, of kerosene type, is generally used in vaporizing types of burner, and the slightly-heavier grade (commonly referred to as " standard domestic oil "), of gas or diesel oil type, in atomizing types of burner.

For domestic use the oil is stored in tanks, normally of welded-sheet mild-steel construction. The larger sizes of tank are installed outside the house, usually in the open and above-ground, and sited so as to be convenient both for supply to the burner and for access from the supplying tanker. Smaller tanks can be placed indoors if there is a suitable room available. The tank capacity selected will depend upon the capacity of the burner, and upon the ease with which supplies can be received in adverse weather conditions; it is usually recommended that the tank should be capable of holding sufficient oil for four or five weeks of worst weather usage. Consideration will also need to be given to the fact that a reduction in price is normally made when oil is bought in quantities of 200 gallons, and upwards, with a further reduction for quantities of 500 gallons and upwards.

All the oil burners applied to domestic central-heating equipment belong to one or other of the two classes referred to above, the vaporizing and the atomizing. The former is used for the lower, and the latter for the higher, rates of combustion. There is no sharp demarcation between the ranges covered by the two types, but the change-over lies somewhere between 50,000 and 100,000 B.t.u./h., corresponding to burning rates between 3 and 6 pints per hour, approximately. The upper limit for vaporizing burners is set by their bulk, since the greater part of the unit is inside the boiler. The lower limit for atomizing burners is set by both economic and manufacturing considerations. The cost of a fully-automatic atomizing burner does not depend greatly upon the output for which it is designed; consequently, when such a burner is applied to a small boiler its cost becomes large compared with the cost of the boiler or with the annual fuel bill. The final orifice in the atomizing nozzle of a 50,000 B.t.u./h. pressure-jet burner is only about seven-thousandths of an inch in diameter, so that there are difficulties of manufacture for small outputs.

Vaporizing Burners

Three types of vaporizing burner are in current use. The *pot* or *carburettor* type of burner consists of a perforated bowl into the bottom of which the oil is fed. The fuel is vaporized, partly by conduction of heat down the walls of the pot and partly by back-radiation from the flame. The design is such that the vapour does not burn at the surface of the oil but rises, mixes with air and burns above the perforations. Some designs depend upon natural draught

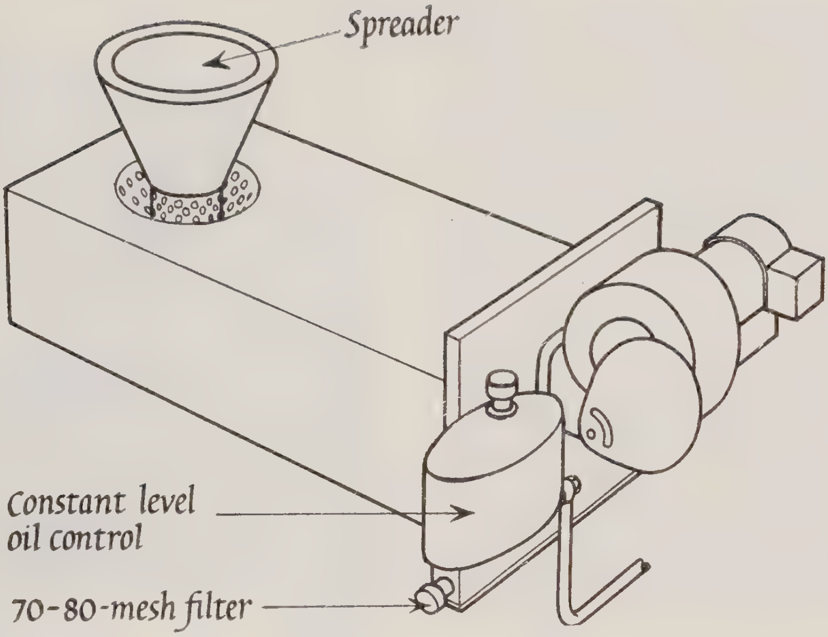

Fig. 5. Forced-draught pot-type vaporizing burner

for their action, while others use a supply of forced air from a small electric fan (see Fig. 5). Becoming increasingly widely used, because of its simplicity and the ease with which it can be adjusted and kept clean, is the *concentric-drum* burner. In this type the fuel is fed into two concentric annular troughs, the inner and outer rims of each carrying a perforated steel drum. Part of the trough has an asbestos wick for the initial warming of the burner and to enable it to be lit. By the chimney effect of the burner, air is induced to enter the holes in the drums and mix with the vaporized fuel. The flame is bluish and mainly within and near the top of the burner when it is hot.

The third form, not yet much seen in this country, is the *spinning-distributor plus hot-ring* burner. The fuel is flung off a rotating disc or cup in comparatively coarse drops towards a surrounding ring of refractory material or heat-resisting steel. In operation the ring becomes sufficiently hot to vaporize the oil before it actually reaches the periphery.

The oil is fed by gravity from the supply tank, passing first through a constant-level reservoir and then through a control valve to the burner. The majority of vaporizing burners are lit by hand and the rate of burning controlled, either manually or by thermostat, on the " high flame-low flame " principle. Considerable efforts have, however, been made to develop " on-off " vaporizing burners so that the advantages of fully automatic control can be secured. In some cases electrical preheating of the oil has been used in conjunction with hot-wire ignition, while in others a small pilot flame stays always alight, the main flame being turned on and off.

Atomizing Burners

Burners of this type are lit by the spark between ignition electrodes and so can be under fully automatic control. A flame-safety device, usually of photoelectric type, is fitted to switch off the oil supplies in the event of a flame failure or a failure of the ignition. Two main types of atomizing burner may be recognised.

In the *pressure-jet burner* the fuel is introduced tangentially into a " swirl " chamber, entering through grooves at a pressure of 80 to 100 p.s.i. The oil circulates in the wall of the chamber and then, as it travels forward, is forced towards the axis. It emerges from the final orifice in the form of an air-cored spinning cylinder of oil, which spreads out and then breaks up into droplets. The air for combustion is supplied through a draught tube in which the nozzle is axially mounted.

Some of the problems of designing an atomizing burner for the lower rates of burning are simplified in the *medium-pressure air atomizing burner*. In this it is arranged that not only the oil but a small proportion, say about 4 per cent., of the air for combustion is passed through the nozzle. This enables much larger passages to be used in the nozzle, but at the expense of greater difficulties in ensuring a constant rate of fuel flow.

Oil-fired Boilers

The best results are obtained when the boiler and its burner are designed to suit each other. A number of efficient types of boiler-burner unit, designed as integral appliances, are available in the output range up to 100,000 B.t.u./h. They are neat and compact (see Fig. 6). The smaller sizes, with vaporizing burners, are suitable for installation in kitchens where space permits. For the larger installation it is usual to employ a conventional boiler, suitable for oil or solid fuel firing, in combination with an atomizing burner, usually with the insertion in the combustion chamber of a certain amount of refractory brick. The brick serves several purposes, including flame stabilization and the provision of a hot environment for the flame. Equipment is available for the adaptation of smaller boilers from solid fuel to oil firing, but generally speaking the smaller the boiler the greater the likelihood that there will be a loss of efficiency in the conversion.

Whole-House Warming Unit

This unit is similar to the appliances described under the same name elsewhere in the paper for use with solid fuel and with gas, providing house heating with ducted warm air. It is available in two forms, both of which use a forced-draught vaporizing burner. One form also provides domestic hot water and is rated to heat a house of about 1,700 sq. ft. area. The other model does not provide hot water and has a higher space heating output, of the order of 80,000 B.t.u./h.

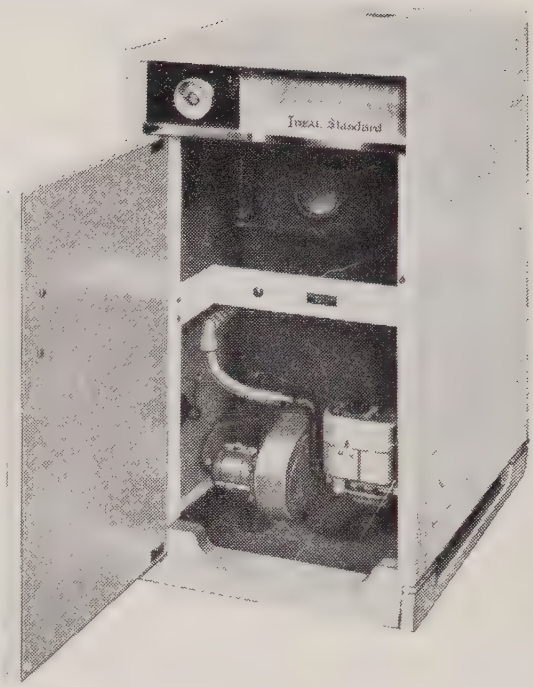

Fig. 6. Oil-fired boiler-burner unit (Idea Boilers and Radiators Ltd.)

Acknowledgements

In preparing this paper the author has drawn freely upon the information contained in the book entitled " Domestic Heating " of which he was recently the Editor and part-author. He is very grateful to the publishers, Temple Press Limited, London, for their ready consent to this and also for making available six blocks to illustrate the paper. He also wishes to thank his co-authors in the book, Messrs. A. R. Bennett, J. B. Dick, G. J. Gollin, W. C. Moss and L. Shepherd who have read the manuscript and made various helpful criticisms and suggestions for its improvement.

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Discussion

Mr. James Goodfellow of Leeds, the Chairman, in opening the meeting said that he was very glad that only one subject was to be dealt with that morning, as it would enable the subject, namely Whole House Warming Systems, to be dealt with very thoroughly.

He said that ever since the rapid building in Britain of working class houses at the time of the industrial revolution British houses had been among the worst heated in the world. Archaic methods of house heating by open coal fires had produced the major part of our atmospheric pollution. Small sections of the British public were now only beginning to realize the futility of suffering a cold draughty house during the winter, together with the insidious nuisance of domestic smoke.

It was to be hoped that whole house warming systems would rapidly spread and provide better heating in the houses of this country, and clean air.

Following Mr. Shaw's introduction of his paper

Mr. Goodfellow said that if anybody ran one of the many kinds of domestic heating systems in their own home, the Conference would be glad to hear of their experiences of running costs, and if they had installed a domestic heating system in their house, they would be glad to know of the capital costs.

Alderman W. L. Dingley (Warwickshire), said that the Chairman had emphasized the desirability of putting their little bits of wisdom together, and of speaking from their personal experience. The thought uppermost in his mind on these matters, was that we were wasteful. He knew that about 15 years before, he had lagged his house, about 14,000 cubic feet, and was certain that he had saved fuel and that he had a greater degree of comfort. One must not waste.

He thanked Mr. Shaw for his paper, which had not been dogmatic. The fact was, he supposed, that they still had a lot to learn. Years ago when they went round the schools, many of them in the rural areas, very often the children had come to a cold school, and for the first half hour could not give much attention to their work because they were shivering, with the stove against a wall, and the flue pipe which led immediately outside. When one put a thermometer (he had not done this in a school, but in his own office), on the wall outside, it was quite evident that through the wall one was losing heat. And speaking from his own experience—he had an anthracite stove in his office—he found that by putting the flue up and along as much as he could inside the building, he gained from the surface exposure of the flue, which was greater than that of the stove itself, and that he could get far more from the flue pipe than he did from the stove. But of course, one must not have it too long, because condensation took place and convection ceased. He wondered were we paying sufficient attention to convection from the flue.

He would also like to ask whether we were experimenting sufficiently upon getting a forced draught with perhaps a fractional motor—he was referring now to domestic heating—so that it would keep the gases going straight through, and one could afford to take more heat out of them; heat radiation, perhaps copper flues or pipes which would readily radiate their heat rather than merely rely on convection. He supposed that perhaps those things had all been done, but he did not know, and as he had said, he came to learn. Going back to the question of central heating for the whole house, he did not think there was any doubt that it gave more comfort in the house. He supposed it was 40 years ago that some of his friends, more affluent than himself, were able to put in central heating. When he visited these friends they were glad to show it to him, and it was very nice and comfortable, and he noticed that when one visited them later on one found that they were tending to raise the temperature all the time; and after six months, in his experience, as one went in the front door, the heat came at one. If one was not careful, as he saw it, one tended to raise the temperature too much.

This brought in the question of cost which was so important. What was the most economic procedure, he asked. He thought they must study that, and get all the information they could. Mr. Shaw had told them that so many conditions differed. He accepted that as far as existing dwellings were concerned, but asked, what about the new dwellings? There was for example the question of the economics of lagging and of double glazing. They all wanted greater comfort, and he personally thought it was possible to have it if they did not waste anything, and if they knew what they wanted, particularly when they were starting *de novo*, but it then depended on cost. One wished to be able to say, with some confidence, that if you proceed in such a way, you will have both the comfort and the most economic procedure. We had not really decided that.

Councillor C. E. Brodie (Ellesmere Port), said that he had recently bought a new house. It had been architecturally designed, and fitted with all the latest modern conveniences, and was centrally heated by gas. The warm air could be selected to heat any room by opening or closing the air ducts which were built into the house. The house was insulated against draughts with fibre-glass wool.

He wanted to be fair in his criticism because they had only been in occupation since last February. First he would like to say how efficient and pleasant was a gas-warmed air central heated house. It was clean, convenient and the temperature was thermostatically controlled. They also had a constant supply of hot water. He mentioned some snags they had met. He was anxious about the fire hazard. The system was situated under the stairs. Gaps had already appeared in the woodwork, which he could only attribute to heat from the system. The North Western Gas Board had assured him it was quite safe and had been most helpful. He felt that they were the guinea pigs and that the troubles would probably be ironed out as they went along.

The atmosphere was inclined to be stuffy, due to the lagging and insulation with the fibre-glass. In order to allow fresh air to circulate they had to open the front and back doors, also the cock loft.

Councillor Brodie referred to the cost. There were only himself and his wife in the house and they were both extremely economical. In his previous house, which was also a new house, built in 1950, the overall cost was about £50 per annum for cooking, electric fires, lighting, television, radio, ironing, etc., also solid premium smokeless fuel and coke for an Ideal combustion stove which supplied hot water. In his new home, he estimated the cost would be £65 per annum, for central heating, cooking and hot water. He thought that with the electricity bill this would bring the total to about £85 to £90 per annum—nearly twice as much as he had been paying before. The average gas consumer was charged 2s. 6d. per therm, and 16s. 8d. per quarter standing charge. He was charged 1s. 3d. per therm, and £2 3s. 4d. per quarter standing charge. It was obvious that a gas centrally heated house would consume more gas than the ordinary house, and he felt that the standing charge of £2 3s. 4d. was much too high. Every penny he had ever owned had been sunk into this new house, and naturally he was looking for economies. Even if he turned the gas off, he was still faced with the very high standing charge. In fact on the last bill the standing charge had been higher than the gas consumed.

Councillor Brodie said that his Council were soon going to discuss the possibility of putting gas central heating into council houses. They would look to him for guidance and experience. He would not be able to recommend it 100 per cent. until the high standing charge were removed, because the average council house tenant with a family would not be able to afford it without a subsidy.

Alderman Mrs. E. M. Millard (Dagenham), said that Dagenham Borough Council had put a scheme of central heating in an early postwar estate comprising over five hundred properties including old people's bungalows, houses, flats and shops. This estate was near their salvage works, which helped in the burning of salvage, and was supplemented by solid fuel. The best advertisement for the estate and for central heating was that if for any reason a tenant moved, he regretted very much giving up his radiator heated house.

Dr. A. Parker (Royal Society of Health), said that Mr. Shaw's paper was a well-balanced and fair account of the subject of whole-house heating by solid, liquid, and gaseous fuels and by electricity. It was an achievement to have presented the salient facts so clearly in one paper. Several points had been raised in the discussion but there was one point of importance to which reference had not been made. Too often the designers of houses completed their designs without adequate consideration of the systems of heating and provision of hot water to be provided. Efficient heating systems using solid, liquid, or gaseous fuels necessarily discharged waste gases at a relatively low temperature and with no more than the necessary amount of excess air to the chimney; if they did not they would not use the fuel efficiently. If the draught was to be satisfactory and there was not to be damage from the condensation of acid liquid, the chimney should be so situated and constructed as to reduce loss of heat from the chimney walls; and in many instances the chimney should be lined with glazed pipes to withstand corrosion and possibly insulated. Architects or designers of houses in general seemed to have little knowledge of these requirements for efficient and trouble-free heating. Numerous houses, even modern houses, had chimneys on outside walls, often projecting from the outside wall, uninsulated, unlined, poorly constructed, and with the outlet at the top below the level of the ridge of the house. As a result, with efficient heating appliances, there was unsatisfactory draught and condensation of acid liquid in the chimney. The acid condensate attacked the joints of the brickwork. These faults of design, position, and construction were continuing in spite of the fact that in consequence after a time thousands of house chimneys had had to be drastically repaired and even re-built. In many instances the acid condensate had also percolated through and damaged plaster and decorations on the walls of rooms. There were official pamphlets giving clear guidance on the requirements. Yet many architects and designers responsible for these faults claim to have a knowledge of the chimney and other requirements for heating systems.

D. C. Henderson (North Eastern Gas Board), queried the capital cost statement which listed the gas-fired ducted warm air system in 1955/56 at £425. Today his Board were installing the " selective system " in existing property for £150 inclusive, except for redecorating. The provision of a gas circulator for hot water would cost approximately £25 more.

The gas-fired warm air system had many advantages over the hot water radiator system, notably quicker response and greater flexibility, and also it provided cool air during the summer months. Another important factor, particularly in tall blocks of flats, was the readily available means for drying clothes indoors.

He asked the author's opinion as to whether it was technically justifiable to use a hot water heat exchanger when a direct fired warm air system was available. Did the author really recommend one dual purpose appliance for heating and hot water, keeping in mind the fuel cost aspect and the fact that one load was seasonal and the other constant?

G. J. Gollin (Consultant), said that much had been heard in the discussion regarding the high cost of whole house heating. Most people would feel insulted if it were suggested to them that they could not afford to run a car, and yet it was doubtful whether one could do an annual mileage of say 5,000 miles for less than £100. Why should such a sum seem exorbitant for the annual heating and domestic hot water cost, he asked. He suspected that it was the husband who derived most benefit from the car, while it was the poor wife who needed the house warming.

He was pleased that previous speakers had commended the combined system of central heating plus domestic hot water supply through an indirect heater. He would like to stress one great advantage of this scheme. The domestic hot water load had an intermittent character and it was rarely that its peak load coincided with that of the heating system. It was therefore possible to exploit the rating of the boiler to the best advantage, the heating circuit borrowing that part of the boiler rating earmarked for hot water supply and at peak load times vice versa. Of the annual oil consumption of say 600 to 1,000 gallons, experience showed that about forty per cent was used for water heating and sixty per cent for the heating season.

K. T. Diamond (Coal Merchants Federation of Wales, Eastern Area), said that it was difficult not to enthuse about the fuel one was interested in, and he wished to speak about a system providing whole house heating for small dwelling-houses, operating from an open fire. It incorporated a new type of back-boiler which made full use of hot flue gases, had a small electric pump, small bore pipes and was capable of supplying four radiators, a towel rail and domestic hot water. He had himself installed such a system and found it very efficient. He said such a system brought whole house heating within the scope of the " man in the street." It could be installed for around £200 and retained the open fire, which was still so popular among British housewives. Most people kept one open fire going and with this system for a small additional amount of fuel, at least background whole-house-heating could be obtained. He thought the idea merited further examination, especially as smokeless solid fuels could be used very successfully with this system.

W. M. Stevenson (South of Scotland Electricity Board), said that the Conference seemed to have been more concerned with the various smokeless fuels than with achieving a really clean healthy atmosphere. He did not see much advantage to the ordinary citizen in using smokeless fuels, if the products of combustion of such fuels still allowed pollution of the atmosphere by the lethal contents.

At present electricity was the only fuel which completely complied with the Clean Air Act, yet strangely enough they had hardly heard it mentioned during this Conference.

He suggested that the Society—if they really felt that they must continue with solid fuels—concentrate their efforts on obtaining a fuel without lethal fumes or smoke. Only then would the Society be doing a real job which would be beneficial to the community. In the meantime he thought more encouragement should be given to electricity and gas, as the new plants for those respective fuels were now being sited outside the densely populated areas where their products of combustion were less likely to cause harm. Both electricity and gas were, after all, coal by wire and pipe.

A. L. Good (Bishop's Stortford), said that he lived in a modern four bedroom semi-detached house, the superficial area being 1,058 square feet. There were seven members of the family, and a fully automatic gas-fired central heating system was installed towards the end of 1960. The original system was gravity feed with indirect cylinder, small storage tank in addition to the normal domestic cold water tank and a 12,000 B.T.U. solid fuel boiler. There was a limited pipe provision for future central heating radiators in the hall and two bedrooms and for a towel rail in the bathroom.

Mr. Good pointed out that after very careful thought he had decided to install a complete central heating system with provision for nine radiators, towel rail, room thermostat and a hand-wound clock control for boiler. The system was designed to continue as a gravity feed. The Eastern Gas Board advised in respect of the installation and carried out the work, the cost of which was £342 7s. 6d. The existing brick flue was lined throughout with asbestos cement pipes.

Mr. Good gave details of comparative annual fuel costs before and after the installation of central heating as follows:

	BEFORE	AFTER	
	£	£	
COKE	50	2	Open fire during very cold weather
GAS (including gas for cooking) ..	12	80	
ELECTRICITY (including immersion heater)	30	20	
	TOTAL £92	TOTAL £102	

The gas-fired boiler rating was 50,000 B.T.U's per hour and the boiler thermostat was operated at about 150°F. under normal conditions. Mr. Good said there was no trouble with regard to condensation. The clock which had to be wound once every 14 days, was set as follows

On 6.30 a.m. Off 2.00 p.m.
On 5.00 p.m. Off 9.00 p.m.

This gave a total daily operating time of 11½ hours with provision for the use of a by-pass whenever necessary.

Mr. Good said the system was very efficient, trouble-free, labour saving to a degree, and well worth the capital outlay. The additional cost of fuel would be offset by savings on decoration.

G. H. Fuidge (Institution of Gas Engineers), said that he had listened with interest to Mr. Shaw's paper and he was sure that all of them, whether as individuals or as representatives of the various fuel interests, were pleased to find that the British public were at last demanding a higher standard of house heating. He had only one comment to make and that, he was afraid, was on the controversial subject of running costs. As a member of the gas industry he could not accept the implication of Mr. Shaw's statement that gas was a markedly more expensive fuel than either solid fuel or oil. It was their experience, particularly in the domestic field, that central heating was almost never whole-house heating, and that householders did not require all the house fully heated all the time. All heating systems were used with some degree of intermittency and usually with only a part of the house fully heated and the remainder with background heating. As a result, the flexibility of a heating system had a very marked effect on the amount of fuel used. Although the commodity price of gas was appreciably higher than that of oil, the greater flexibility meant that for the normal domestic installation heating, say a house of up to 1,500 sq. ft. area, the fuel costs were about the same for gas as for oil, and when account was taken of the lower capital cost of the gas installation, the overall running cost was lower for gas.

He hoped that the Conference would not think that those remarks were intended just as publicity for gas, but he did not want the Conference to feel that for house heating, gas was almost ruled out because of cost. The enormous increase in the sales of gas heating appliances, for both individual room heating and for central heating, showed that this was not so.

P. Draper (Shell-Mex and B.P. Ltd.), thought that Mr. Shaw had given an excellent survey of the present picture, although it was a pity that he had not been able to give any comparative costs for heating the modern home; but he agreed with the author that it would be very difficult to do so in view of the variation in fuel prices up and down the country and the lack of reliable information on boiler thermal efficiencies.

The author had ventured to put forward comparative installation costs based on a Building Research Station Digest of 1955/56, but Mr. Draper thought it useful to point out that the business was now becoming more competitive. Complete central heating and hot water installations in small houses were being quoted for such prices as gas £285, oil £298, coke £270 and anthracite £305; the installation in each case comprising five radiators, towel rail, boiler, hot water cylinder and all ancillary equipment. Thus it would appear that the choice for the householder would lie in the ease of operation and fuel running costs, remembering that the very simple type of coke boiler quoted would have a considerably lower efficiency than any of the other boilers.

Councillor C. W. G. Martin (Esher), commenting on the possible systems of payment for heating in council properties, reported that in a recently opened ' House Mother ' block at Cobham, Surrey, the main domestic heating for the elderly residents was provided by a central oil-fired unit, the cost of such heat being included in the rent. At night, however, the boiler was switched off, and during such hours (or at any other time if required) the tenants could switch on the small electric fires in their individual rooms, paying for current consumed.

He would accept the Chairman's invitation to give some particulars of his own domestic running costs. In his former house partial central heating had been achieved by a semi-automatic hopper-fed solid fuel boiler using anthracite grains. The thermo-syphonic system, with 4 radiators upstairs and 4 down, was installed for £350 when the house was 15 years old. (This did not, of course, include the cost of the 4 fireplaces already installed when the house was built.) Boiler fuel was 4½ to 5 tons per annum (say £55 to £60) which normally sufficed for all but the largest room, the lounge, and occasionally the dining room, where the radiators were helped out in cold weather by an open grate. Electric fires were used where necessary in bedrooms, but the central unit provided most of the house heating. A test of the auxiliary heating, carried out almost by accident, had shown amusing results. On this occasion, the room, already warmed to 62°F. by its admittedly badly sited radiator, was reduced 2°F. in temperature owing to the chimney draught created by lighting a coal fire! In this case, therefore, it was preferable, and not only for purposes of smokeless combustion, to use an electric fire, or most effective of all, a portable kerosene heater, as a booster. He estimated that the total annual cost of all fuels—coal, coke, wood, kerosene and electricity—was anything up to £70 to £75.

For exactly three years now he had occupied a new house with the oil-fired central heating system designed with the house, the only really satisfactory way of achieving one's object. He deliberately used the phrase ' central heating ' and not ' whole house heating ' since, like the other house, there was no attempt to provide full heat at all times in all rooms. However, the heating, which was by skirting lengths where ever practicable, and by convector or radiator elsewhere, was calculated to give 68°F. in main ground floor rooms and something over 60°F. in bedrooms and elsewhere. Excellent insulation was provided by Thermalite bricks for the inner skin of the cavity walls, and the loft was lined with fibre-glass over the rafters. A 70,000 B.T.U. boiler unit, with pressure-jet burner consuming gas oil, with small bore piping, had cost about £650, complete with oil tank, indirect cylinder, pump, time switch, thermostats (including an exterior ' frost stat ') and so on. But against this must be set the definite *saving* of having no fireplaces at all in living rooms or bedrooms. As the initial quotation for a fireplace in the lounge (only desired in the first place for appearances!) was £230 for this one room only, by the time that the grate, surround, chimney stack and reinforcements had been allowed for (and a second fireplace in the dining room could have cost nearly as much) it would seem fair to say that the true prime cost of the central heating installation was certainly not more than £250 to £300. It could even be argued that, with a new house designed from the start in this way, the cost of a real house heating plant might be little more than that of a traditional design with perhaps five or six separate fireplaces, all of which had to be paid for. He imagined that this was a point seldom considered in calculations.

The house itself was a semi-bungalow, that is, the ground floor was fully self-contained, with a bedroom and bathroom in addition to normal rooms. The ground floor area was about 1,200 square feet, plus a further 350 square feet in the garage and lobby, the latter housing the boiler. The upper floor of 550 square feet (making 2,100 in all) was heated only by convection with a bonus from sundry hot water pipes intelligently sited. Electric fires were available for the relatively rare occasions when more was required. He had found that the hall convector also provided considerable background warmth up the open central staircase.

Accurate consumption figures had been taken over the three years, a small drop having been noticed each year, as experience was gained in the optimum periods of switching off the system and in varying the boiler thermostat setting at different seasons. Consumption now only slightly exceeded 800 gallons per annum, for a family of at first four, and latterly three adults, two of whom were normally out during the day. Obviously with more in family the consumption would rise. The cost of fuel during the first year was £52, but with the fuel tax this was now £58 approximately. It would be fair, however, to allow in addition for £6 a year for a boiler maintenance contract, and £2 for electricity directly consumed. It had occurred to him to check this latter figure, and South Eastern Electricity Board had kindly co-operated by lending an extra meter for plugging in around the circuit. The whole boiler system and its gadgets used from 0·26 units/day in high summer, to 2·0 units/day in the coldest fortnight of winter. The figure of £2 assumed a nigh average of 1·1 units/day.

To avoid bias he felt it would be fair to allow a further £4 to £5 for contingencies, such as the sporadic electric fire, which would make the total annual charge about £71. Thus, with intelligent handling of the controls fitted just for that purpose, and with adequate lagging and insulation from the start, the running costs could even be cheaper than with a ' mixed ' heating arrangement, apart from being trouble free, dust free, and, of especial importance to the Conference, smoke free.

Councillor C. A. Watson (Scunthorpe), said that the advantages of central heating both to the householders and to the progress towards clean air were not and could not be in question. Indeed, it might be said with considerable truth that British heating and plumbing systems were a disgrace to a community which even pretended to be forward looking and civilized. However, he was extremely disappointed by the contents of the paper—both in their substance and in the discussion which they had so far provoked. They had heard experiences of individuals, which in the main, and as could be expected, indicated the advantages of each and every system referred to in the paper, and of the advantages of all the fules used and recommended. They had had also, the expected sales talk from representatives of all the recommended fuels, each lauding the advantages of his own particular fuel and making completely contradictory comments as to the capital costs involved in the burning of such fuels in central heating installations. All this had made confusion in his own mind absolute.

He said that he asked himself what was the purpose of the paper, and to whom was it addressed. It seemed to him that all that had been said referred to the middle classes who could afford to spend £300 to £400 on the installation of central heating, but what of the vast majority of people who burned most coal, made most smoke, and had the most inefficient appliances from a clean air point of view. To his mind, not one word in the paper referred to the vast field of air polluters. It would be true to say that the building programme over the next ten to fifteen years would be something like 400,000 houses a year, at least 300,000 of which would be built for the working classes. Those houses were built almost to a standard pattern and design and in his judgment constituted a very inviting field for central heating. Indeed, it would be true to say that it was questionable whether up to that time 400,000 houses a year had been converted to smokeless fuel by the operation of Smokeless Zones.

Was it then beyond the capacity of the industry to design a few standard central heating systems aimed to be adapted where necessary for the extremely large number of houses in the existing building programme. Any successful effort in that direction would make installation of central heating systems a part of the building of the house, thus reducing the capital costs considerably and giving the benefits of central heating to an ever increasing proportion of the community.

A. C. Hazel (Powell Duffryn Heating Ltd.), said that he would like to add his congratulations to Mr. Shaw on his paper, but he hoped he would not mind his drawing attention to one important point, particularly as that point was discussed by many overseas delegates who were attending the International Heating and Ventilating Conference in London only a few days prior to the Clean Air Conference.

He referred to the fact that the greatest complication in house heating was the window, and that it was now generally agreed among research people in various countries, that the radiator should not only extend practically to floor level, but it should also be tailored to window width. In other words this was considered to be more satisfactory than putting low level radiators the full length of the outside wall. Reference might also be made to the fact that that same principle applied to oil-filled electric radiators which were the electrical equivalent of the hot water radiator system.

One appreciated that Mr. Shaw could not deal with everything in domestic heating in one short paper, and he was to be congratulated on the way he had condensed a great deal of information on a very difficult subject in a comparatively few words.

Time would tell which system would become the most popular but we might takes note of the experience of our friends on the Continent, where today over ninety per cent. of domestic central heating was in the form of radiators dealing effectively with the down-draught window problem.

Author's Reply

Mr. Shaw said that it was always a matter of great satisfaction to the author of a paper when, as on this occasion, its presentation was followed by a lively and wide-ranging discussion.

One feature of particular interest was that, following *Mr. Goodfellow's* opening of the discussion, when he invited members to give information on their experiences with their own central heating systems, some five systems, all different, were described in detail. *Councillor Brodie* had a gas-fired ducted warm air system with thermostatic control. *Mr. Diamond* had chosen a solid fuel open fire with high-output back boiler in association with radiators fed by small-bore forced-circulation. *Mr. Good* had recently installed a fully-automatic gas-fired hot water system, with room thermostat and clock controls. *Councillor Martin* had formerly lived in a house with a hot water system operated from an anthracite gravity-feed boiler. Recently he had moved to a house with forced-circulation small-bore hot water heating derived from an oil-fired boiler with full thermostatic and time switch controls. All appeared well satisfied with the standard of comfort and the service given. Their estimates of running costs were encouraging and, in several cases, comparative figures were available which demonstrated that the running cost of the central heating system was, in fact, only comparatively little higher than for the traditional heating arrangements which had been superseded.

Several speakers, including those referred to above, gave information about the capital costs of the systems which they had installed or of which they were aware, while others queried or criticised the figures which were quoted in the paper from B.R.S. Digest No. 93. Here Mr. Shaw could only reiterate his statement that " truly comparative information on these subjects is very scanty." Before figures from other sources could be compared with those in the Digest it was necessary to be sure that like was really being compared with like, and it would be desirable to study the Digest in detail to see precisely what items of equipment and construction it covered. It should be borne in mind also that the cost figures which it gave were not just laboratory estimates but were based on actual tenders, to a suitable specification, from suitable firms of heating engineers. It was quite clear that the cost of a gas-fired selective heating system installed in an existing house, as quoted by *Mr. Henderson,* was not directly comparable with the B.R.S. figures. It seemed doubtful, also whether the figures given by *Mr. Draper* for four types of installation were derived on the same basis as the B.R.S. costs. It was, however, certainly noteworthy that the extreme range of costs as quoted by *Mr. Draper* was considerably less than that of the Digest, particularly in respect of oil *vis-a-vis* the other fuels.

The importance of house insulation and the need to avoid cold down-draughts were referred to by several speakers. *Alderman Dingley*, who had lagged his existing house and was confident that he had thereby both saved fuel and gained comfort, nevertheless thought that the economics of insulation and of double glazing in new houses still needed careful consideration. It should be noted that the Building Research Station has devoted a good deal of effort to this problem, and the Station's recent papers and publications would repay study. *Mr. Hazel*, in advocating the use of under-window radiators to combat down-draught, emphasized the necessity for these radiators to cover the full width of the window and to reach down almost to floor level.

Alderman Dingley also referred to the heat which came from the flues of stoves—and was often wasted because of the run of the flue—and wondered whether sufficient attention was paid to this source of heat. Mr. Shaw said that the modern trend was to make the appliance itself as thermally efficient as practicable, so that there was a minimum of heat in the flue gases to be either wasted, or recovered but not necessarily at places where it was required. This was obviously preferable to any device for attempting to obtain convected heat from hot gases passing through the flue pipe. The practical limit was set by the need to ensure that the flue gases were not cooled to the point at which they would condense in the flue, and this limit could be approached, and in some cases reached, with modern designs. Flue condensation must be guarded against both in the design of the appliance and, as *Dr. Parker* had pointed out, in the construction and siting of the flue; all too often the flue was uninsulated and cooled by being on an outside wall. He very rightly emphasized the grave dangers of acid liquor condensation in domestic chimneys. *Dr. Parker* also stressed the importance of designing a house and its heating system as an integral unit, a contention in which he was strongly supported by *Councillor Martin* who described this as " the only really satisfactory way of achieving one's object ".

Mr. Henderson asked whether it was technically justifiable to use a hot-water heat exchanger when a direct-fired warm air system was available. Mr. Shaw thought that the answer to this was generally " No." With gas-firing, if warm air was required then direct air heating was both available and technically efficient, and it would probably be preferable to have a separate gas-fired unit, such as a circulator or boiler, for the domestic hot water; certainly this was the policy of the gas industry, which appeared to have set its face against the design of a combined warm-air and hot-water gas-fired heater. To a considerable extent this particular question was also bound up with *Mr. Henderson's* second question, " did the author really recommend one dual-purpose appliance for both heating and hot water." As far as Mr. Shaw could see he had not advocated this in his paper, and he was not sure that there was a unique answer to the question. When the space heating was derived from a hot water boiler, then there was no reason why the domestic hot water should not be taken from the same source, and many people would claim there were excellent reasons for so doing. It was clear from *Mr. Collin's* comments that he was an enthusiastic supporter of the dual-purpose system, and he had called attention to the advantages of flexibility in such a scheme.

Mr. Fridge pointed out that, in practice, all heating systems were used with some degree of intermittency, and that the high degree of flexibility associated with gas meant that the same comfort service could be obtained from the supply of a lesser amount of heat than would be needed with less flexible systems or fuels. In practice, therefore, a gas-fired system would not prove to be so costly to run as the useful therm figures in the paper would appear to suggest. Mr. Shaw considered that, while this argument would undoubtedly be true for intermittently operated systems, operation of this type was really characteristic only of partial or selective systems and not of full central heating systems. The comparative figures in the paper were, of course, based on the assumption that the same total amount of heat would be required, in any particular household, irrespective of the source or fuel from which it was derived. Mr. Shaw was of the opinion that this assumption was likely to be broadly true over the greater part of the central heating field. *Councillor Brodie*, who had a gas-fired system, was very critical of the high standing charge which he had to pay for gas. Mr. Shaw felt that fuel prices were notoriously controversial matters but that there was a very good case for some re-thinking about gas standing charges. In this matter he could only speak as a householder, but he felt that there must be other ways of presenting price inducements which psychologically were much more attractive.

Finally Mr. Shaw came to the contribution of *Councillor Watson* which was, in the main, critical of the content of the paper. Here, however, it had to be remembered that the author had done what he was asked to do, and that was to review the subject of whole-house heating as it existed today. The paper was a factual review of the methods, fuels and equipment currently available for whole-house heating, it was completely nonpartisan, and its central theme was that all types of fuel had their part to play. It was not intended to be a review of domestic heating practice as a whole, nor did it attempt to forecast or guide the future of domestic heating as a whole, in the light of clean air policy; in either event the paper would have assumed a very different shape.

Councillor Watson had said, and the author would agree, that the subject of the paper was mainly of interest to the middle classes, and he went on to ask whether it would be possible to design a few standard central heating systems which could be adapted for the houses of a wider range of the population. It should be recalled that in the early post-war years the Ministry of Fuel and Power organized an investigation into the possibility of introducing whole-house heating into local authority-type housing, and some fifty houses were built by eight local authorities and the experiences of the tenants studied. The published conclusions of the investigation (Lant and Weston, J. Inst. Fuel, **25,** 1952, p. 109) included the following important statements: " To some extent the building of smaller houses may increase the proportion favouring whole-house heating but, clearly, whole-house heating is appropriate only for a small proportion of the prospective tenants of local-authority housing. . . . Experience at Abbots Langley suggests that greater hardship results from putting a family whose expenditure on heating must be small into a house with whole-house heating, than from putting a family which prefers a house which is warmed throughout, and can afford to pay for the heating, into a house with a modern open-fire warming only the ground floor." Since that was written methods involving lower capital and running costs had been developed, and the purchasing power of much of the population had increased, but Mr. Shaw doubted whether the main truth of these conclusions had been in any way invalidated.

OPERATION OF THE CLEAN AIR ACT: SMOKE CONTROL AREAS

I. WHY SUCH SLOW PROGRESS?

G. W. Herrick, D.P.A., F.A.P.H.I.[*]

AT last year's Conference Dr. Turner presented a paper summarizing the replies to questionnaires sent out by the Society. In it he described the response in providing information from the 324 areas designated " black areas " as overwhelming and commented that there were signs that activity in creating smoke control areas was gaining momentum. Nevertheless, Dr. Turner gave the opinion in his summing up that " progress will have to be accelerated if a substantial portion of the 324 ' black areas ' is dealt with in the next few years . . . it is encouraging that there is some indication that this is a possibility from figures published in H.M.S.O. Cmd. 1113, 1960." When asked to prepare a paper which must, of necessity, be largely a follow up of last year's deliberations, it was natural to turn first to this publication of the Ministry of Housing and Local Government, entitled " Smoke Control ".

No cause for optimism

Detailed and objective study of this document certainly supports Dr. Turner's plea for the need for acceleration, but I must demur on his opinion that it offers encouragement. Indeed, surely any clean air enthusiast must find the contents, taken as a whole, thoroughly depressing reading. In any case, the introductory comment leaves no doubt that the Minister is far from happy with the progress made. Let us look at some of the main facts set out. Eighty-six Local Authorities in England and 29 in Wales, had not responded to the Minister's invitation to submit programmes by March 31st, 1960. Perhaps more ominous was the statement that progress achieved by Local Authorities in 1959 fell a good deal short of what had been planned. In the circumstances, it was not surprising to find the introduction ending with a request that Local Authorities should review the progress made in planning and executing the programmes for their areas.

Regional Comparisons

The Regional tabulations are most informative. From them we glean that the County of London, though showing some unevenness in planning and action, seems to have a fair chance of being virtually smoke-controlled during the present decade. Several Metropolitan Boroughs have certainly set and are maintaining a hot pace. The Greater London authorities for the most part also seem to be making reasonable progress. As it is generally accepted that the 1952 London Smog triggered off the granting of powers we now have in dealing with air pollution problems from domestic chimneys, this is perhaps no more than should be expected. In the other Regions, however, the rate of progress varies enormously, with the number of local authorities making really good progress pitifully small in most cases.

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These striking contrasts point to three general types of approach. First, there are local authorities who started early and ambitiously and, with growing experience, have proved that they can maintain and even accelerate their activities. Second, are those who made a pedestrian start, setting a leisurely pace which they seem happy to pursue. Here I would include those authorities who have been content to confine their attention so far, to open spaces and new estates. Third, there are those authorities who, after nearly five years, remain completely inactive.

Why the differences ?

Parliament has provided the tools for action leaving local Councils to get on with the job. One would have thought that with the opportunity to make a major step forward in public health, there would have been a much more uniform and generally enthusiastic response. It is certainly appropriate for this Conference anxiously to examine why such differences in approach should be in evidence. Are there real and legitimate causes for the present state of affairs?

Anybody who has been closely engaged in smoke control work knows that many questions of detail and interpretation arise on which decisions must be made, but how many of you share my opinion that at conferences and meetings of this Society and at those of the professional associations concerned there has been too much dwelling on the difficulties in creating and operating smoke control areas? Can it be wondered at if delegates from Local Authorities still to take the plunge or proceeding hesitantly, get anxious and diffident after attending these meetings or reading the resulting publicity. This does not mean that the whole undertaking should not be kept under constant review in the light of experience. My complaint is solely aimed at any negative tendencies which can so easily provide excuses for inaction. In good endeavours difficulties should not deter; rather they are to be faced and, if possible, overcome.

Positive approach succeeds

In what is essentially a partnership enterprise, the attitudes of Councils and their staffs must have a direct bearing on the reactions by the public. Let it first be stated, therefore, and kept in mind during our discussion today, that a number of Local Authorities all over the country have already positively and clearly demonstrated that smoke control areas can be brought about within the existing law and directives acceptably to all concerned. Indeed, if experience in Fulham is any guide, goodwill builds up and the task becomes easier as progress is made.

Directly the Act came into operation, my Council considered detailed proposals, prepared by the officers during the Bill stage, to make the whole Borough smoke controlled within ten years. This was endorsed with the proviso that there would be reconsideration of this decision annually to see whether any speeding up could be undertaken. Already in the light of experience the Council have amended their plan to complete the project within eight years. This now involves dealing within around 6,000 dwellings a year. So far (October, 1961) 16,953 dwellings are subject to smoke control orders. The annual review decision remains.

This patent demonstration of their own determination and widely publicized enthusiasm has left no doubts in the minds of both officers and the public. Officers like clear policy directives, particularly when they present a real challenge to their administrative and technical skills. In anticipating a favourable response, remembering that these were early days, my Council showed some courage in gauging public reactions They were fortified, however, by the knowledge that various air pollution problems were of topical local interest. They also knew that there was already a marked tendency towards the use of smokeless fuels, particularly to gas and electricity. Events so far have proved their leadership to have been soundly based.

The nice division between the policy makers and the executive essential to good local government has been followed to enable applications for grant to be dealt with expeditiously. A series of policy decisions by the Council establish precedents which enable the officers to act in nearly all cases. Now only the very occasional case presenting some exceptional feature needs the prior consideration of the public health committee.

That no question was raised on the substantial financing of the programme points to the ready acceptance that the cost was regarded as a sound investment in public health.

Public reactions

A Council which presents such a clear lead is not only entitled to, but invariably receives, a matching response from its staff. As one of the team engaged I can only comment that the programme has been successfully kept up-to-date. By design or happy accident it happens that all engaged on this work practise what they preach, having put their own houses in order at their own expense. In discussions with the public this fact casually mentioned often resolves the last doubt.

Before preparing this paper I asked my colleagues in our clean air section to comment freely on the way they had been received by householders and to give their own assessment on public reactions. It emerged that they had met no real obstructiveness. This matches up with the fact that there have been no formal objections to the Council's smoke control orders and therefore no public local inquiries. The only criticisms arose when proposals for conversion proved unacceptable within the rules laid down, but these were mild in nature and soon resolved by reasonable explanations. More interesting was their opinion of a subtle change in general attitude over the years. In the first smoke control area quite a number of occupiers, though not patently anti-smoke control, gave an impression of fatalism in accepting something new being imposed by " the Town Hall ". This phase seems to have changed progressively and decidedly to an attitude of much more ready co-operation. Instances of people going out of their way to tell us how pleased they are with their new and adapted appliances have increased and are increasing. Appreciative letters are received in numbers almost constituting a fan mail of proportions new in my long experience. Some teething troubles arise due to unfamiliarity with the changes in technique required to burn the authorized solid smokeless fuels satisfactorily and economically, but advice and, where necessary, practical demonstrations, soon overcomes them.

Our experience so far is that applicants are usually very reasonable in their proposals, largely being content to meet their obligations at or near the minimum possible cost. Whether this will continue in subsequent areas remains to be seen. One does appreciate that circumstances can vary considerably even within the confines of one Borough and your experiences in this regard may well be very different. In the comparatively few cases where builders' specifications and estimates are considered inadequate or excessive, discussions bring about agreement before the form of approval is sent to the applicant. These consultations have played quite a part in ensuring working without acrimony. When unforeseen contingencies arise in the course of works have the effect of raising costs, supplementary estimates are invited and, where appropriate, approval is given to increased grant.

Less costly than anticipated

It is interesting and very important to note how the actual number of conversions subject to grant aid has compared with the estimated number of conversions required taken from the survey particulars. The figures for our first two areas are as follows:

	Conversions, etc. Estimated	Actual
Smoke Control Area No. 1	4,015	1,494
Smoke Control Area No. 2	3,685	1,177

From the progress made to date with our third area it would seem that a ratio of roughly 4-1 will emerge. I can assure you that nothing is left undone in the matters of "public relations" and information services, which my Council take very seriously. From conversations with colleagues from other areas, it would seem that this ratio between estimates and performance is a fairly common experience. Indeed, the tendency appears even more marked in many Boroughs operating on like policy decisions than in Fulham. The financial implications are obvious.

Few offences

Smoke emissions from domestic chimneys in the smoke control areas have been few. Regular weekday observations and spot checks on Sundays have brought to light only 43 offences since 1958. Warning letters have succeeded in preventing subsequent offences in all cases. It can only be assumed, therefore, that householders from whom the expected applications did not materialize have made their own arrangements. To our knowledge many are using oil heaters or portable electric fires. Quite a number choose to burn one of the more reactive solid smokeless fuels in their existing grates, albeit uneconomically and risking the supply position. This is a pity, as a steep rise in fuel costs or difficulties of supply could provide an unreasonable criticism of the project.

I am coming more and more of the opinion, as time goes by, that one should not be unduly worried. After all, the object of the exercise—smoke-free domestic chimneys—is there for all to see. I have heard it said that there is a danger of some reverting to coal burning after the immediate hue and cry dies down, though over several winters this has not happened in Fulham so far. Mention has also been made of the fluidity of local populations and that new tenants may easily offend unwittingly. These things can and do happen, but they seem to me primarily excellent reasons why we should get on with our tasks as quickly as possible. When it is general knowledge there is no market for household coal over a large area, any such worries will disappear automatically.

If then our experience can be taken as a guide—and I am sure Fulham residents would not wish to be deemed remarkable in this connection—it does seem any Council which holds up action on the score of unfavourable public reaction may well have come to the wrong conclusion and would be wise to reconsider the matter.

A systematic approach

With such a detailed and complicated procedure to operate and a time schedule to fulfil, the need for sound administration is obvious. Taking one large area a year has many advantages, not least in enabling overlapping cycles of operation to be followed, enabling planning in advance, particularly as regards printing requirements and arranging of exhibitions. I can commend this method of approach. An example of the sequence of action is shown at the top of the next page.

Following this orderly course of action brings a number of benefits. Reducing the number of Smoke Control Orders, with their accompanying paraphernalia of schedules, correspondence, etc., saves administrative time. Allowing the maximum time possible, outside the heating season, between dates of confirmation and operation is an obvious advantage to be sought for it minimizes inconvenience to residents. The resulting opportunity to give good notice of action enables householders to make

SPECIMEN PROCEDURE CYCLES

August, 1959	Letter to householders introducing scheme for No. 1 Area and stating survey assistant will call. Survey for No. 1 Area commences.	
August, 1960	Survey for No. 1 Area completed. Letter to householders introducing scheme for No. 2 Area and stating survey assistant will call. Survey for No. 2 Area commences.	
September, 1960	Smoke Control Order No. 1 made by Council and submitted to Minister.	
January, 1961	Smoke Control Order No. 1 confirmed by Minister. Householders and other interested parties notified fully as required. Press publicity.	Applications for approval of adaptations, etc. and for grants in Smoke Control Area No. 1 dealt with.
February, 1961	Static and mobile exhibitions in No. 1 Area.	
June, 1961	Reminder to householders in No. 1 Area.	
August, 1961	Survey for No. 2 Area completed. Letter to householders introducing scheme for No. 3 Area and stating survey assistant will call. Survey for No. 3 Area commences.	
September, 1961	Smoke Control Order No. 2 made by Council and submitted to Minister	
October, 1961	Smoke Control Order No. 1 operative. *et seq.*	

advance plans for ordering correct fuels and to take any advantage of summer prices.

It will be seen, however, that the smooth working of these cycles of operation relies heavily on two factors outside the Council's control. First, continuance of the absence of formal objections and consequent public local enquires. Secondly, that there is no hold-up in the Minister's confirmation being received.

Sound administration implies a pruning of any unnecessary tasks (including keeping paper work to a minimum), good inter-departmental liaison, all aimed to bring about a basic routine suitable to the purpose and leaving limited key staff as clear as possible to get on with their jobs. In any case the public would have a legitimate cause for complaint if action on their applications is delayed or grants are not paid speedily on satisfactory completion of works because the administrative machine creaks. This is not the least important aspect of the "public relations" approach which must pervade the whole enterprise.

There is an obligation to do everything possible to see that everybody affected is kept fully informed. The various ways of doing this are well-known and call for no special comment. In Fulham we have found the staging of an exhibition, timed to coincide nearly with the Minister's confirmation and held within the area concerned, of the utmost benefit. The timing is stressed, as people show greater interest when they know they must make up their minds straight away and have the opportunity of seeing the alternatives available displayed to facilitate their decision.

Calls for changes

Those responsible for framing the provisions of the Act, memorandum and subsequent advices under which we have had to work were faced with quite a task, and it says much for them that some Councils at least have done so well within the framework provided. Enough experience has been accumulated, however, legitimately to draw attention to the need to reconsider certain aspects. Opinions are ripening that modifications of the existing procedures could be made with advantage. Recommendations and resolutions have already been sent to the Minister from authoritative bodies in this regard.

So far the only change towards simplification has been the cutting out of the prior approval stage, which has been only a minor relief to most Councils. Having gone that far, however, I wonder (here I am kite flying to get your views) whether Councils like my own have now amassed enough experience to do away with the survey stage altogether. It seems to me the survey has had two advantages of substance, (1) advance publicity and (2) later saving of the time of technical officers when applications match up exactly with survey particulars. Against these can be placed (1) the substantial cost in man hours and salaries involved, (2) the fact that in very many cases in the subsequent inevitable time lag, circumstances and preferences change, (3) that in any event applications must be dealt with on their merits at the time of making, (4) that with experience estimates of likely total cost can be arrived at for submission to our own Councils and the Ministry which will compare favourably in accuracy with those based on the survey, and above all (5) that in the event applications for grate conversions will not arise from many of the householders visited, rendering many survey visits abortive. In passing, at least one Council, to my knowledge, conducts its survey mainly by post; this is an interesting alternative about which I hope we shall hear more at this Conference.

Another suggestion for change being much canvassed calls for powers to make grants regarding premises not yet in smoke control areas. We often hear the plea " when is our turn coming? ". It is frustrating to have to dampen enthusiasm and give answers which must seem somewhat arbitrary. The London and Home Counties Clean Air Advisory Council in pressing this alteration, suggest the Minister should declare large areas to be Smoke Control Areas to be developed over a number of years, in which the suggested advance action can be taken. You may feel this is a useful suggestion for debate.

The same Council is joined by the South East Division of this Society in advocating the investigation of the possibility of introducing a scheme for fixed prices similar to the housing improvement grants. There is an appreciation that this could only be applied to the commoner forms of adaptation and alterations and that there might have to be regional variations. I approach this suggestion warily. We have found that one of the strengths of our present way of carrying on is that justice can be done in every individual case. A little elasticity can be applied to our carefully compiled approved price ranges if circumstances warrant. That adjoining authorities in which the same owners and builders operate may accord slightly different treatment to similar circumstances is a fact, but slight illogicalities of this sort seem a small price to pay for preserving the utmost local discretion in operating a scheme on which many feel the hand of Whitehall is already heavy enough.

Last year, Mr. W. H. Wattleworth (Liverpool), raised the important question of the brake on progress which is occasioned by following the traditional full public inquiry procedure in cases where there are few objectors only. He advocated some form of private inquiry in such cases on the lines possible within slum clearance procedure. I can only add my full support for this excellent suggestion which does nothing to deny the principle of the right of objection, but puts things in proper perspective.

Less revolutionary suggestions for change on which I would like your views involve two essentially practical points each with financial implications. First, those much debated items the " fixed but readily removable " appliances. We have got far enough ahead in Fulham to revisit a number of cases after two years where 7/20ths grant was originally paid. Out of the 51 appliances concerned, 49 were still *in situ*. Naturally I do not know who thought of this differentiation originally. It looks like a typical Treasury safeguard, but surely a sledgehammer has been used to crack a nut. Gas and electric appliance manufacturers have been put to the trouble of adding fixings, that no one really wants, to standard equipment. When turning down the full grant initially to occupiers wishing to fix appliances coming under the definition, the guilty knowledge that the average coke grate can be removed with very little more trouble is always in the front of our minds. My wish is to see this differentiation go as I feel the risks of financial loss due to sharp practice are more than offset by the troubles occasioned to so many.

Second, to my knowledge, many colleagues in other Boroughs share my feelings that it is unfortunate that " throat restrictors " do not rank for grant *per se;* to include them for grant where they are not an integral part of an approved fitting it is necessary to make a special case for Ministry approval. It can be clearly demonstrated how valuable this very inexpensive addition (a matter of shillings each is involved) can be in raising heat efficiency and comfort standards and therefore making the change more acceptable. At our suggestion some applicants fit them at their own expense, but most do not. From a public relations angle the comparatively trifling saving in public expenditure resulting from this ruling might prove to be dearly won.

Conclusion

The day when one could say anything new about creating and operating Smoke Control Areas is past, and in offering this Paper for your discussion I am very conscious of this. Nevertheless, I hope Conference will agree that in the circumstances a renewed call for a greater sense of urgency is not misplaced, and also that the time has come for a critical appraisement of the tools we have to hand.

I can vouch for the fact that it is a pleasant and reassuring experience to view a smoke control area from a high building on a cold winter's day and to note the absence of smoke from the domestic chimneys. In a few years' time one wonders what residents of Boroughs known to be completely smoke-controlled will think if a smoke haze is seen drifting in from adjoining areas.

THE
SOLID SMOKELESS FUELS POSITION

Presented by David E. Baird

*for the Solid Smokeless Fuel Federation**

THE term Solid Smokeless Fuels is applied to both certain natural fuels and to certain manufactured fuels.

The natural fuels, *e.g.*, Anthracite and Welsh Dry Steam Coal are mined in the same manner as coal and after cleaning and sizing are ready for sale to the market.

The manufactured fuels differ according to the class and quality of the coal from which they are made, the plant in which the coal is carbonized and the conditions of the carbonization process. Accordingly, there are considerable differences in their reactivity and their bulk density. After their treatment in the carbonization plant, they are sized before marketing.

For the purposes of the Clean Air Act and their use on the domestic market, all these fuels can be put broadly into three categories, namely:

1. Those suitable for use on any type of open fire.
2. Those suitable for use on approved open fires to B.S.2845, with a minimum fire bar spacing of ⅝ in.
3. Those suitable for use on openable stoves, closed stoves and hot water/central heating boilers.

If we now consider each of these categories in turn, we can place all the known smokeless fuels into one or more of these categories as follows:

(1) *Suitable for any open fire*

These fuels are generally the most reactive and are sometimes referred to as Premium fuels.

They are Cleanglow and Phimax, produced by the gas industry; Coalite and Rexco produced by the low temperature carbonization industry and Warmco produced by the National Coal Board.

(2) *Suitable for Approved Open Fires to B.S.*2845

In this category, we have fuels to the British Standard 3142. A large proportion of this B.S. fuel is marketed by Gas Boards under the names of Gloco and Sebrite—the latter being produced by the South Eastern Gas Board.

Also in this category can be placed the natural smokeless fuel known as Low Volatile Steam Coal from South Wales.

For certain types of approved open fires, viz., the under floor draught fires and more recently the induced draught open fires, Sunbrite manufactured by the Coking Industry is also a suitable fuel.

(3) *Suitable for openable and closed stoves and hot water/central heating boilers*

A British Standard for fuels for these appliances is in due course of preparation.

The suitable fuels are:

(*a*) The natural smokeless fuels—Anthracite and Welsh Dry Steam Coal in their appropriate sizes.

(*b*) Gas coke of the size appropriate for the appliance. (This is variously marketed as Selected Nuts, Gloco Nuts, Sebrite Nuts or No. 3 Gas Coke).

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* A joint paper by the constituent members of the Federation.

(*c*) Sunbrite—the trade name for all hard coke—of the size appropriate for the appliances.

(*d*) Phurnacite—a carbonized ovoid of a standard size.

(*e*) Coalite, Rexco, and Warmco Nuts—again in the size appropriate for the appliance.

Availability

The overall supply position, *i.e.*, the total supply of all our three categories of fuel is ample and, as far as can be seen, perfectly adequate to meet the demands likely to be made on this supply from the application of the Clean Air Act.

But, within this general statement, it must be appreciated that supplies of a particular fuel in a particular category and in a particular locality are not and never can be always available. This happens with a number of commodities, local shortages occur but substitutes are available and, in practice, the consumer is ultimately satisfied.

In the solid smokeless fuels market in practice, consumer choice of appliance and fuel, about which we shall be talking a little later, will spread the demand for suitable fuels over the whole range of these fuels and, therefore, apart from sudden and comparatively short lived stringency of supply due mainly to transport and distribution difficulties, non-availability of supplies should not occur. As an example of this sort of situation, you will all be aware that recently the Minister of Housing and Local Government has advised Local Authorities in the area of the Northern Gas Board—roughly Northumberland, Durham, part of Yorkshire, Cumberland and Westmorland, that grants would be available for the installation of the openable or closed stoves in place of approved open fires because Sunbrite and Category 3 fuel were in ample supply in that area, whereas Category 1 and 2 fuels were not so readily available.

This precedent may well be followed in other parts of the country and it is one that Local Authorities should bear in mind considering the establishment of new smokeless zones.

The main objection raised to the extension of the grants for approved fires and stoves is naturally that of cost to the Local Authority, but while these appliances are admittedly more expensive, in a number of cases installation costs can be substantially lower and the householder may well be prepared to pay some of the extra cost himself to obtain a more efficient appliance.

Again, speaking generally, on the overall situation it can be stated that so far there has not been one case where a request to establish a Smoke Control Area has been rejected, due to an insufficient supply of suitable smokeless fuels.

Now let us turn to considering the estimates of supply requirements and the actual tonnages that were and are available.

The Beaver Committee[1] reporting in 1954, envisaged the replacement of some 19 million tons of bitumous coal by some 15 million tons of solid smokeless fuels (if no other fuel such as gas or electricity were used) within a period of 10-13 years.

Six years later, *i.e.*, April 1960, the Peech Committee[2] reported on the estimated requirements and availability of solid smokeless fuels up to 1965.

From Table II, on page 27 of the Committee's report, the following figures have been extracted:

	Sales in 1959 *Tons*	*Availability forecast for* 1961 *Tons*
Fuels in Category 1	910,000	1,440,000
Fuels in Category 2	1,050,000	2,807,000
Fuels in Category 3	3,612,000	6,469,000

For the year ended March 31st, 1961, the *fuels produced* were:

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[1] Report of Committee on Air Pollution. Cmd. 9322. Nov. 1954.

[2] Report of the Committee on Solid Smokeless Fuels. Cmd. 999. Mar. 1.

	Tons
Category 1	1,275,000
Category 2	2,000,000
Category 3	6,150,000

These figures of fuel production for the 1960/61 heating season are exclusive of stock withdrawals and it must be emphasized that at the end of March last, the stocks of Sunbrite at producers plants were just over three million tons and in the gas industry stocks at works were 1,800,000 tons.

It will be noted that there was an increase in the production of fuels in all groups over the amounts sold in 1959, and this increase compares reasonably favourably with the availability forecast for the future.

The producers of solid smokeless fuels have geared themselves to produce the fuels required for immediate use and have made, or are making long term plans to meet future requirements. It has been argued that the extension of smoke control areas has been delayed due to an anticipated shortage of the Category 1 fuels. But, as the figures show, the production of these fuels has kept pace with demand and, moreover, there is considerable flexibility in output potential of them, particularly in the gas industry. Apart from the fuels that have already been mentioned, two new smokeless fuels which will fall into Category 1, are presently being produced by the National Coal Board from a Pilot Plant at Birch Coppice in Warwickshire and from another Pilot Plant at Graigola in South Wales. If all goes well with these Pilot Plants, substantial quantities of these fuels are expected from commercial plants by 1965.

Consumer Choice

The Clean Air Act has been responsible for making many people think for the first time in their lives about the methods and economics of heating their homes. For too long, we, as a nation, have been conditioned to cheap and abundant fuel and have used it wastefully and with little or no regard to atmospheric pollution. This is now changing and when the change is actually made in an individual's house, we want the change to result in better warmth, cleaner conditions and more economical use of both the nation's fuel and the individual's own money.

Consequently, it is most important that all the facts are placed before him and that he be given the opportunity of deciding—with details of the financial assistance available to him—which appliance or appliances and which fuel he wishes to use. It is, at this point, that the services of the Solid Smokeless Fuels Federation are available and can be used by the Local Authority for information, demonstration to the consumers and for collaboration between the distributors in the locality and the producers of the various fuels.

One has seen, from time to time, from correspondence in the papers and from enquiries that have been called by the Minister of Housing and Local Government, that there is in some instances an assumption that all residents within Smoke Control Areas wish to burn solely the Category 1 fuels. This is not so. The experience that the S.S.F.F. has from its many visits and exhibitions is that people are genuinely looking for information that will enable them to make their own decision as to which they consider is the appliance and the fuel most suitable to their personal needs.

Now this can only be done if the consumer has (1) full knowledge of all the appliances and all the fuels available; (2) that the selected appliance is correctly installed and (3) that the consumer has been educated in the use of the appliance and the fuel. This calls for good Public Relations in the first place where again S.S.F.F.—with no axe to grind—can, we suggest, be of great help and, in the second place, of close co-operation between Local Authority, the fuel distributors and the producers.

The Local Authority should ensure that the residents are fully aware of the implications of the Act, of the monies that are available to them under Grant, that the correct appliance has been selected and installed and, if considered necessary, arrange demonstrations to show the residents how the fuels should be burned.

The fuel merchants should ensure that their customers have a full knowledge of the fuels which can be obtained and used within the area and be prepared to offer, either themselves, or through the producers, a good consumer service. Many leading fuel merchants and producers offer this service and are prepared to give demonstrations in the consumer's own home, whilst large-scale demonstrations can be arranged by one of the Organizations formed for this purpose.

There is no doubt that a proportion of the market will demand and continue to use one of the more reactive fuels but it is possible that the demand for these may have been over-estimated, because in many cases it has been found through experience and through surveys that some consumers, when first changing from coal, use one of the more reactive fuels either because little or no change of burning technique is called for, or because they have not troubled to install a modern appliance, or because the full range of fuels available to them is not known; but eventually they try one of the other fuels, find it satisfactory, and, in many cases, continue to use it.

Appliances

It is appreciated that although it is a condition of approval of Local Authority expenses for payment of Exchequer contributions that new solid smokeless fuels appliances be selected from the Approved Domestic Solid Fuel Appliance handbook published jointly by the S.S.F.F. and the C.U.C., the selection is limited to the type of conversion necessary and it is felt that some Local Authorities have generally stuck too rigidly to installing the cheapest appliance, and that not enough people have been persuaded to change their old stool bottom grate and fret for an approved type of fire with $\frac{5}{8}$ in. fire bar spacing, or openable stove, to enable them to burn a wider range of fuels to give higher efficiency and a better service.

It has been found that many people are prepared to pay something additional to the Grant to install a better appliance, either a Convector or a Stove, and it is felt that this should be encouraged wherever possible.

Conclusions

From reports presented to this Conference in previous years, it has been noted that established Smoke Control Areas are now working efficiently, that the consumers are receiving their fuel regularly and are satisfied with the performance of the fuel they are burning, but in some instances this satisfaction has been delayed, not due to the non-availability of suitable fuels, but due to the circumstances previously mentioned that can be overcome by co-operation, education and good public relations.

The Federation has learned through years of experience, organizing Clean Air Campaigns and demonstrating in Smoke Control Areas, that the public wants clean air and that this demand continues to grow with the experience gained with Smoke Control Areas. The public, however, have much to learn about the fuels and the appliances. They are keen to learn how to burn the fuels and are proud of their ability to do so once they have been shown.

Discussion

F. J. Redstone (Bristol), in opening the discussion, said that he was sure that those present were grateful to Mr. Herrick for his excellent paper. It certainly seemed that the County of London was doing very well in the declaration of Smoke Control Areas. If this were due to a competitive element between the boroughs, it was certainly all to the good. Could it be, he asked, that a closely-knit area gained something from the example of its neighbours, whereas this was not so evident in towns some distance from one another. The citizens of the capital city, of course, realized by bitter experience the need for a cleaner atmosphere and the " London Smog " of 1952 had no doubt had a profound effect upon public opinion. Whatever the reason, they congratulated London on its progress.

Mr. Herrick had classified local authorities into three groups. The first group was doing well; the second group had made a pedestrian start and was proceeding slowly; the third group failed to implement the smoke control clauses of the Clean Air Act. They could not here criticize the first group. With regard to the second group—there might be something to be said in their favour. It was clear they were gaining experience as they went, linking that with publicity to encourage other districts of their town to accept, indeed to demand, inclusion in Smoke Control—this, in a democracy, had much to commend it and many local authorities would do best with a policy of " persistent graduality." What of the third group who had failed to institute Smoke Control, he asked. The keen and enthusiastic man could not understand the apparent apathy of another, but they must try to find the reasons and see what could be done to cause a start to be made in the backward areas. From the information before Conference it was clear that 25 per cent. of local authorities in " black areas " had not yet started to clean up their atmospheres with the help of Smoke Control Area procedure. They were seeking reasons for that today—was it fear that there would be a breakdown in the supply of smokeless fuels, Mr. Redstone asked. If this were so, maybe they would be reassured by the clear statement made on the previous Wednesday by the Parliamentary Secretary of the Ministry of Power. Was it that Micawber-like they were waiting for something to turn up, which would solve problems without expense. It was true that industry in all areas had made a splendid effort to comply with the Clean Air Act, and that improved-type grates were being voluntarily installed in every area in both new and existing houses. However, it must be recognized that the owners of houses with old-type grates were not to blame for that, and that it was a co-operative job to secure replacement by suitable grant aid.

We were citizens of the nation—not of one particular district, and were entitled to breathe clean air in whatever part of the country we are destined to live in or visit. What had to be faced was that there was not ready acceptance in every area by all concerned, that the cost involved was a good investment in Public Health. That might be due to a failure of the Officers and Committees concerned to prepare the city or town by adequate publicity over a sufficient period to accept Smoke Control proposals as in the public interest and, if this were so, the sooner it was started the better. It was obvious that whatever was said nationally about clean air, this local concern and sustained interest was vital in every case.

He did not wish to comment on difficulties in the operation of Smoke Control Areas because those could be resolved by arrangements already in being at Fulham and other areas, whereby policy decisions of the Council enabled officers to act—other than where exceptional problems were presented for Committee decision.

He seriously suggested that it might be interesting and useful if the Minister of Housing and Local Government asked the towns who had not yet commenced Smoke Control why this was so.

If those delegates with information or opinions on that matter would take part in the discussion, Mr. Herrick would not consider the time and thought given to the preparation of his paper to have been in vain.

Bailie G. A. Snodgrass (Glasgow, and Chairman of the Clean Air Council for Scotland), said that as industry was now spending very large sums of money on prevention of smoke and grit emission, it might be considered that the emphasis of next year's Conference could be changed towards spending more time on domestic smoke prevention. It would appear that the domestic fire was now responsible for two-thirds of the smoke pollution of the country. He referred to the fact that the Clean Air Council for Scotland had formed a Publicity Sub-Committee with Mr. Innes as Chairman to endeavour to make useful suggestions to the Secretary of State for Scotland to hasten domestic smoke abatement.

The President, in his most inspiring address, had made it clear to them all that terrible suffering was being caused by air pollution.

Thousands of people were going to die in the next few years because Councils had delayed action in establishing smoke control areas. He felt it essential that the truth must be brought home to them, and they must be left with no excuses about difficulties of survey, availability of smokeless fuels, or in waiting for a special fuel which the Coal Board might eventually produce.

Dr. W. R. Martine (Birmingham and British Medical Association), assured Mr. Herrick that, were surveys to be dispensed with as he had suggested, the educational value of the survey would be lost. He believed that visits of explanation limited the risk of objection and resultant formal enquiry, and, in Birmingham, now in the process of surveying the City's 67th Smoke Control Area, there had so far been no need for such inquiry.

Mr. Beaumont, Chief Smoke Inspector, Birmingham, who was unfortunately unable to attend Conference this year, had, however, drawn his attention to one very real cause for grievance, not mentioned by Mr. Herrick. This related to grants towards expenditure incurred in providing means of ignition of solid smokeless fuels.

Ministry Circular 31/61 referred to " works of adaptation eligible for grant," and stated that the provisions as to means for gas ignition could now also be applied to electrical ignition. " Adaptation " was the crucial word here, and if no works were entailed no grant was payable. If there was a gas or electric point near a fireplace, neither gas poker nor electric igniter would qualify for grant. The cost of the former might be negligible but the electric igniter was an expensive item. Electric points were commonly found adjacent to fireplaces much more so than gas points. Would it not be more practical as well as more economical to provide an electric igniter under grant in such cases than to provide a gas point from quite a distance with its attendant disturbance of floor boards, etc., and, often, a cost far in excess of that of the electric igniter? Only by fairness would the goodwill of the public be obtained, and retained, and it must not be forgotten that that goodwill was an essential to clean air progress. So let the igniter qualify for grant, and, incidentally reduce the cost to householder, to local authority, and, nationally, to the taxpayer.

N. Bastable (Barking), said that in 1960 Barking Council had embarked upon a programme designed to make the whole of the borough smoke controlled in five years. This involved dealing with approximately 4,000 dwellings each year.

So far, one Order in respect of 4,622 dwellings had been confirmed by the Minister, and would come into operation on January 1, 1962. One Order was with the Minister at present, and a third Order was about to be sent to the Minister. A total of 8,851 dwellings had so far been surveyed. No objections had yet been encountered. A great deal of preliminary publicity had been carried out over the past ten years by way of lectures and exhibitions which had undoubtedly been effective and helpful in preparing the way for more positive steps.

The surveys for the Smoke Control Areas had all been carried out by post, so far with great success. A form had been delivered for occupiers to complete which only entailed a mark being made against the appliances in use in the various rooms and an estimate of the amount of fuel used. The form was sent with a letter of explanation with the Ministry's printed leaflet and a reply-paid envelope.

In one area comprising entirely houses owned by the London County Council, 98 per cent. of the forms were returned completed satisfactorily. In mixed areas of privately owned, tenanted and owner/occupied houses the number returned had been a little less. An inspector visited the houses from which no return was received. Generally 75 per cent. of forms were returned within one week of the date of despatch. An area of 2,000 could be surveyed in three to four months.

The outstanding advantage of this system was that the problem of not being able to gain access during the day had been overcome. This appeared to be a very real problem in areas where the survey was done by personal call. It had been said that by a postal system the opportunity was lost to spread propaganda but it was doubtful if an investigator had time to indulge in long chats if he were going to complete a survey in a reasonable time. On the other hand, by completing a form the occupier was actively participating in the scheme and was thereby impressed that something was going on in which he should be interested.

It had been found that the value of having an individual sheet for each house was immense in the subsequent administrative work involved after confirmation of the Order. Even if there were a change in the information required at the time the Order was made, there was still a need for a record of the appliances available in each dwelling.

A. Cordwell (Sale), posed a question to Mr. Herrick with regard to the number of properties in each of the areas (the details of which were given in his paper) where the occupant or owner had failed to comply with the recommendations made within the prescribed period, that was, between the date of confirmation and the date of operation of the appropriate Smoke Control Order. The question was asked in regard to the procedure adopted in such cases in order that the terms of the Clean Air Act be fulfilled and thereby ensuring that all occupants had appliances capable of burning smokeless fuels, thus minimizing the risk of an offence being committed.

Councillor A. C. Good (Hornchurch), said that what seemed to them to be trivial objections representing almost a lunatic fringe had delayed Hornchurch's No. 3 smokeless zone order coming into operation for a period of about ten months. The Ministry had urged local authorities to get on with the job; the Minister had been pressing them to proceed without delay. They in Hornchurch had striven to do that, but had experienced a sense of frustration. It made him wonder whether the Ministry had the same sense of urgency as they showed at Hornchurch.

He said that in January the Hornchurch Council made an order to establish its No. 3 Smokeless Zone and was anxious that it should come into operation not later than September. But what had happened was that at the local public inquiry there had been a few objections of a rather trivial nature. One was to the effect that smokeless fuel cost too much; another from a man who said he had fought in the war and fought for freedom. Accordingly the Ministry, in confirming the Order, had postponed the date of its operation until July 1, 1962. Councillor Good said that it should surely be possible to devise machinery to speed up the process of the implementation of Smoke Control Orders and to prevent them being delayed by such trifling objections. The existing machinery was cumbersome. If there were objections which were not withdrawn it was necessary to go through the procedure of a local public inquiry. He could appreciate this where it could be shown that there were legitimate objections, but where, as in the recent case in Hornchurch, they were demonstrably futile, he felt that it was a great pity that the Ministry could not exercise means to evaluate objections and thus speed up the process.

Councillor Good said that the Hornchurch Council's clean air programme spanned eight years. That seemed a very long time, but even over that period it meant taking on extra staff and £8,000 from the rates. The Council was in earnest about making the district a fit one to breathe in, and considered the expenditure of time and effort worthwhile. He hoped, however, that the Ministry would, by its actions, indicate that it was equally enthusiastic to do everything possible to avoid unnecessary delay.

L. Mair (Newcastle-upon-Tyne), said that when he read Mr. Herrick's paper he had been particularly interested by the reference to a positive approach which ought to be made by local authorities when dealing with smoke control areas. In Newcastle-upon-Tyne, his own authority, they were well ahead of schedule. They would be completely smokeless well within the prescribed period, but as far as the north-east in general was concerned, that would mark the end of a happy tale. Progress in the north-east was pitifully slow compared with the Metropolitan area and parts of Lancashire. That was due to circumstances which did not exist in other parts of the country.

Mr. Mair continued by pointing out that around Newcastle the mobile exhibition vans of the Solid Smokeless Fuels Federation had given excellent service. They had also created a tremendous demand for solid smokeless fuel. The householders in smoke control areas were able to visit the exhibitions and see stoves burning beautifully with Gloco, Warmco, Coalite and Rexco. When they wished to purchase those fuels they had to be told that there were no supplies available. A lucky purchaser might be able to buy soft coke from the gas company, but the less lucky individuals would have to find their own solution. Mr. Mair affirmed that this was the whole problem of the north-east. The conference delegates knew that during the opening session an assurance had been given by the Parliamentary Secretary to the Ministry of Power that there was no need for them to worry. A plentiful supply of solid smokeless fuel would become available. It was unreasonable to expect the author of the paper to give an answer to the speaker's question which was as follows: just where was the solid smokeless fuel coming from. They had none in the north-east. When they dealt with smoke control areas, the north-eastern authorities were far too diffident, timid and indeed apathetic. That attitude was justified to a point, because they were being unnecessarily and unjustifiably handicapped by the complete absence of a national fuel policy. Mr. Mair wished to expand his remarks, but in view of the time factor he invited Mr. Herrick to comment at once on the absence of solid smokeless fuel in the north-east.

In a written contribution Mr. Mair added to the above:

Another aspect which was creating difficulty in the smooth execution of smoke control programmes was the obstructive attitude of certain coal merchants. In his own area there had been cases where householders had in all innocence been persuaded by their coal merchants to accept coal which had been described by the merchant as low volatile fuel, when in fact it was not. In Newcastle a small quantity, about fifty tons per annum, of low volatile fuel was in fact distributed, but this allocation created an opportunity for the less scrupulous coal merchant to mislead householders and to cause them quite unwittingly to contravene the smoke control order by burning what was in fact bituminous coal. In another case a householder was informed by the coal merchant that his particular coal was special " clean " coal and could be used in a smoke control area without any fear. Again this was found to be bituminous coal. He was sure that not one of these particular householders would have knowingly contravened a smoke control order, and there seemed to be no machinery to deal with such unscrupulous coal merchants. He personally found it impossible to identify low volatile coal merely by looking at it, and if a proximate analysis was necessary, what powers had we to procure samples and from whom would they be obtained, he asked. And in any event what was low volatile coal? Would the 20 per cent volatiles basis be accepted in legal proceedings for a contravention of a smoke control order?

Mr. Mair said that perhaps his most intractable problem in a smoke control area arose from the inadequacy of the law in dealing with certain smoke emissions in a smoke control area. The area in the centre of Newcastle and which abutted the river was purely industrial in character and there were in fact no inhabitants. People were there only during working hours. While there was a laudable enthusiasm among managements in that area for smoke control one could easily understand their resentment when they saw waste trade refuse being burnt on the ground in large quantities causing large volumes of black smoke to pollute the comparatively clean atmosphere of the smoke control area. That smoke was not being emitted from a chimney, therefore Section 1 did not apply. Neither could the smoke control order affect it, and as there were no inhabitants in the area Section 16 relating to smoke nuisance was of no use. It seemed a ridiculous state of affairs when, if refuse were burned in an incinerator the chimney of which emitted smoke, an offence was committed, but if it were burned in a heap on the ground creating volumes of black smoke, there was no legal control.

Councillor W. A. Newman (Ipswich), did not think they were falling back through lack of manpower or apparatus. Probably the question of costs was partly responsible, and some local authorities where the problem was acute might feel the burden too heavy to bear. He felt that as air pollution was a national problem much more of the cost should be borne by the Exchequer—that would spread the burden evenly over the whole community. He said that they were like an army marching into battle with no sense of direction, working in isolated groups without a general staff to direct operations. Beyond endless circulars on matters which they already knew about, little help was given by government departments. Councillor Newman concluded by making an appeal for consideration at future Conferences for more time and opportunity to be given to rank and file members to state what really was in their minds.

M. F. G. Randall (Hornchurch), said that at Hornchurch they had gained experience in conducting a postal survey to obtain particulars required in the formation of a smoke control area. They had used the Post Office Business Reply Service sending out 5,000 questionnaires in one area, of which 4,000 had been returned duly completed within four months. They sent a duplicate form to the remaining 1,000 and within a further two months 800 of these questionnaires had been returned. They therefore received information from 96 per cent. of the premises within the area. They considered that to be satisfactory and were of the opinion that for a district such as theirs the postal survey method was very satisfactory in comparison with the previous method of personal visits by the Public Health Inspector. In that instance they had saved six months full-time work of an Inspector and considerable expenditure. For the suburbs in particular, the survey was most suitable, but if they had had a very difficult area including many old houses in multiple lettings, they could have dealt with that portion by personal visits. Following a postal survey they visited all cases where an application for a grant was actually received. When one's programme could be delayed and completely upset by public inquiries, it was very helpful to be able to conduct a postal survey for other areas when the Inspectors were fully occupied in dealing with adaptations prior to a Smoke Control Order coming into force.

It had been said that the information required was too complicated to obtain by post, but a nation that found no difficulty in filling in its football coupons could surely complete a Smoke Control Area questionnaire if it were intelligently devised.

P. H. G. Grimmett (Wednesfield) referred to postal surveys and said that he had undertaken a partial survey in that way over a council estate area comprising some 2,000 to 2,500 houses still in course of erection at that time, and indicated that the rent collectors of the authority had kindly delivered most of them, but invariably the difficulties arose by reason of questions put to collectors which were beyond their ken. It did mean that often a personal visit was needed to offset this, and to introduce the particular scheme. He was of the opinion that it was better to undertake a personal survey so that there could be that introduction and education accomplished with the people.

Referring to the comments in Mr. Herrick's paper, regarding advance grants to people who wished to convert and who were not incorporated in smoke control areas, Mr. Grimmett asked that this should not be undertaken and reminded the Conference that they had been informed that 25 per cent. of the local authorities in the black areas had not yet commenced smoke control activity and had no order in force. He would ask that a more positive approach be continued in that local authority members might in their contacts with each other and at their various meetings, civic and otherwise, discuss with neighbouring local authorities the question of the implementation of the Clean Air Act and thus persuade recalcitrant authorities to act.

Mr. Grimmett observed that there were three orders in his Authority operative covering 567 acres, and such areas were taken as large areas rather than small amounts in different scattered places, and he advised Conference that a new area was before Committee for transmission to the Government on approval by Council and that in that area 10 per cent. of the inhabitants were already conforming to the smoke control and people could be advised of the time they would be coming under smoke control against the five-year programme which had been presented to the Ministry.

Mr. Grimmett wondered if he or the Chairman dare ask the members of Conference present to raise their hands if they were conforming to smoke control in their own homes, and finally Mr. Grimmett said he would advise Conference that every senior officer of the Authority which he served conformed to the requirement of the Clean Air Act, and did not have a grant to do so.

G. O. Allen (Scunthorpe), raised the following point:

Circular 31/61 entitled " Works of Adaptation for Grant," Paragraph 26(10) of the memorandum stated that for the purposes of approving expenditure under Section 12(i) of the Act, necessary incidental works *of adaptation might* include the provision of gas ignition to open fireplaces.

The circular went on to say that reasonable freedom of choice between gas and electrical ignition should be given to owners or occupiers provided that in any particular case the total cost of the alternative was broadly comparable.

In his opinion the circular was not correct. The exact words of the paragraph referred to were: " Necessary incidental works might include the provision of gas ignition to open fireplaces, and extensions of gas piping or electric cable, but not the provision of additional fuel storage space." The words " of adaptation " were not mentioned in the memorandum and the paragraph could be read that gas ignition to fireplaces (now including electric ignition) could be allowed. If the sentence had read on " together with extensions, etc., etc." he would not have raised that point.

He was informed that an electric ignition would only rank for grant if other work such as the provision of socket outlets were carried out. A householder who had a suitable socket outlet by the side of his fireplace could not obtain a grant for an electric firelighter.

In respect to the words " broadly comparable " it had been suggested to him that a householder who wanted an electric lighter could have one (freedom of choice) provided he paid the difference between that and a gas ignition. That was said in spite of the fact that the cost of electric firelighters was known well in advance of the publication of the circular.

Councillor C. A. Watson (Scunthorpe), said that he would like to thank the Chairman for the opportunity given him to make his contribution to that morning's discussion, even though discussion had been closed. He would however, in consequence be brief. Progress in the extension of Control Areas was, as had been stated, extremely slow. One speaker had referred to a period of eighteen months elapsing between making the application to the Minister for a Smoke Control Area and the decision as to the date of its operation. Conference might remember that the year before he had referred to the same period, eighteen months, experienced by the Scunthorpe Borough Council. It therefore appeared that central administration was as slow and majestic as ever.

There had been a number of reasons put forward for such disappointing progress and the point that struck him was, had anybody any idea, any record, of the kinds of problems which contributed towards slowness? Had any attempt been made to ascertain why, even in black areas, no start had in so many cases been made. Was there any information as to the contradictory or evasive decisions and authorities received from the Ministry regarding queries raised by local authorities? The eligibility of electric lighters had been mentioned and was typical of what was happening in many other cases.

The Act had been in operation for something like four years. Was it not time that the Society conducted a survey of the whole field of the operation of the Act, if necessary using sample authorities as it had done for the national survey spoken about on the first day of Conference. It did seem that if such a survey were conducted, and it could conceivably take one year or two, that at least they should have some factual information as to what caused the retardation of the progress they all so earnestly desired. He would not at that stage suggest the headings for such a survey, but he urged that during the compilation of the scope of the survey, the smaller local authorities be asked to take part and also that the success or otherwise of the Alkali Inspectors' work be investigated.

It seemed to him that one of the weaknesses of that and previous Conferences was that all papers submitted and all weighty contributions were received only from conurbations and large cities, especially London and its surroundings. This tended to suggest that in the minds of their council smaller authorities either had no problems or were incapable of making intelligent contributions. This was surely wrong. It might well be that the larger authorities covered wider fields and had different problems but from his knowledge of the matter mainly gained at Conference, the larger authorities could and did take on staff to deal with the operation of Smoke Control Areas, whereas in many of the smaller authorities the work had to be " worked in " with the other duties of the health authorities. In his opinion, there was a sad need for factual knowledge, particularly of the reasons why hesitant authorities were not as keen as others in their desire to create smoke control areas. Without factual knowledge they were merely hoping that somehow they would get along, and that, he suggested, was not a suitable attitude for the Society.

Sir John Charrington (Charrington, Gardner, Locket & Co. Ltd.), in opening the discussion on Mr. Baird's paper, said that he found himself in complete agreement with everything in the paper, but he thought there was a danger of complacency about the available supplies of solid smokeless fuel. He believed that the Chairman thought that the shortage was often exaggerated and that the position was better than it looked. So it was under certain circumstances. There was no doubt whatever that if they had abundant supplies of the more reactive fuels, Coalite, Cleanglo, Rexco and Phimax in Lancashire, they should have no problems whatsoever.

Sir John continued that as a distributor he could sell those fuels as easily as he liked, and he should be entirely happy. However, the only big reserve was the British standard gas coke, Gloco and Sebrite, as it was coming to be known about the country. There lay a problem. There was so much uneasiness in a federation of coke distributors, of which he was himself Chairman, that recently they had held an all-day conference, not behind closed doors but with the Ministry of Fuel, the Ministry of Housing and Local Government, the Gas Council and others. The purpose was to try and make their minds up definitely whether the British standard gas coke was going to prove acceptable to the public. If it did not prove acceptable, the couse of clean air would be very difficult indeed. They had come to a unanimous conclusion that it was acceptable, but only under certain conditions.

Sir John thought that there were two vital things. One was that the correct appliance must be correctly installed and that the supplier of fuel had to be prepared to go and help the consumer become accustomed to the fuel and to enjoying its use. It was not an easy fuel to sell, but under Mr. Cooke's chairmanship they had set up a working party, and they were determined to tackle that subject in more ways than one. He felt that it would be necessary to bring greater pressure upon local authorities to ensure that coke burning grates were installed as widely as possible before an area became smoke controlled. Coke distributors would undoubtedly have to become proficient in helping their customers to use coke satisfactorily, and to achieve this, it would possibly be necessary to get the gas boards to apply more pressure to this end. Coke of the Gloco type could undoubtedly provide a satisfactory fire, but it would need quite a big effort by all concerned to ensure that result.

Authors' Replies

Mr. Herrick replied: It is pleasing that my paper has evoked such an informed and helpful discussion. Speakers have made their contributions clearly and concisely. Most of what they had to say can be regarded as additions to my paper, so any further comments of mine need only be made selectively and in amplification.

Nothing has been said against the positive approach I advocated. There was full agreement that any adverse public reactions to smoke control would be most exceptional. One did note, however, that speakers came mainly from areas where good progress was being made, so the question as to why many authorities still show such reluctance to start remains unresolved.

In his thoughtful opening, Mr. Redstone had some kind words for what he described as a policy of "persistent graduality". The concept of the inevitability of gradualness is not unknown to political theorists and has its attractions. In the context we are considering, however, so much depends on how "persistent graduality" is interpreted. After all, the liveliest councils can be said to be proceeding in this way, as well as those acting with persistence but very gradually. I think my paper leaves no doubt of my own views.

Conference will join me in expressing gratitude to the several speakers who spoke so illuminatingly on the subject of surveys. The concensus of opinion is in favour of their retention, mainly due to the opportunities of education and advance publicity they afford. The accounts of the postal surveys undertaken at Barking, Hornchurch and Wednesfield will be followed with special interest. Messrs. Bastable, Randall and Grimmett gave their experiences factually and fairly, being careful to state the types of area involved. I shall be surprised if their example is not followed, for it does seem that there are benefits to be gained, both in speeding up action and in overcoming difficulties arising on questions of staffing and financing as compared with the orthodox method.

Mr. Mair and others raised pertinent questions on the supply and quality of solid smokeless fuels. Mr. Baird and his colleagues are here to deal with these questions authoritatively, so I will be content to say that no such difficulties had arisen in Fulham. Provided customers placed their orders giving the merchants reasonable notice according to the time of year, as was always necessary when ordering coal, they obtained the fuel of their choice.

The question raised by Mr. Mair regarding burning of large quantities of trade waste in the open in his area is interesting and, of course, really calls for a legal opinion. I just wonder whether "neighbourhood" in Section 16 is not being interpreted too narrowly. Surely such gross air pollution as described would adversely affect inhabitants well beyond the immediate vicinity. It is to be hoped that Mr. Mair will ultimately find the solution to his problem and will favour us with an account of the outcome in the Society's journal.

Mr. Cordwell's question was, in my opinion, worthy of a Conference session on its own. It certainly did not admit of a simple answer in the time available. As promised from the microphone, Mr. Cordwell and I have since been in correspondence. Perhaps a good way to bring out the implications of the question is to contrast the broad policies pursued at Sale and Fulham. The same ends are sought by both authorities, but the means employed differ sharply. Sale Council have decided that the best means of minimizing risks of offences is to ensure that all grates found to require adaptation shall be dealt with, preferably voluntarily, otherwise where necessary by the service of notices. One takes it that in any cases of non-compliance, the works in default procedure will be operated. Fulham Council, on the other hand, after budgeting for a maximum response, seek to leave no legitimate excuses for inaction by householders in the period between the dates of confirmation and operation, and then will only serve notices during a further limited period to " legalize " applications just out of time, due possibly to delays by builders and similar special circumstances. At the moment the Council act in this way for three months, though it is known that there are other Councils working on similar lines to Fulham who allow no period of grace whatsoever. It follows that any householders subsequently finding that they need adaptations to avoid offending will have to make their own arrangements and meet any costs involved. Subsequent offenders not heeding warnings risk legal proceedings. In all the circumstances this line of action does not seen unreasonable to me, particularly as in most cases the costs involved are modest by present-day standards and are offset by raised heating standards. The Fulham mode of operation must inevitably be speedier and, in the event, has proved less expensive to operate than the Sale method. These are the facts, but what is really important is that both councils have made clear policy decisions, no doubt born of their local experience, and are getting on with the job of implementing them.

Dr. Martine and Mr. Allen raised ignition questions which have certainly got to be answered. They are among the multitude of doubts regarding details which have become our daily concern. Each local authority must make up its own mind after getting the best advice it can when dealing with these matters. The only view I care to express is that given alternatives, the most generous interpretation should aid in preserving good public relations.

It was mentioned in my paper that the receiving of the Minister's confirmation in reasonable time was one of the pre-requisites of working the cycles of operation outlined. Both Councillor Good and Councillor Watson drew attention to cases of delays upsetting programmes. One has heard of other cases of long waits for the Minister's confirmation and I can only again emphasize this can have sorry effects.

The discussion has left no doubts that Conference welcomed the opportunity of a further debate on this important field of our public health work. May I conclude by reminding members of local authorities that officers can be as enthusiastic as could be wished, but only they, the members, can give the green light signal to go ahead.

D. E. Baird, replying to Mr. Mair's contribution, writes: It is not the case that there are no supplies of solid smokeless fuel available in the North East. The S.S.F.F. paper showed that there are ample supplies of " Suubrite " available and this is an excellent smokeless fuel. It was for this reason that the local authorities in the Northern Region are empowered to make grants for the installation of suitable appliances for burning " Sunbrite ". In actual fact, there are adequate supplies of open-fire fuel available compared with that being used at present, and a cutting from the *Evening Chronicle*, Newcastle-upon-Tyne, dated November 21st, 1961, confirms this point. It reads:

" Although local authorities in the North East had estimated demand for open-fire coke for smoke control areas in operation on June 21st this year, at 14,000 tons a year, sales in these areas are running at an annual rate of only 6,000 tons.

" This is stated in a letter from the Ministry of Housing and Local Government to Mr. J. Donkin, honorary secretary of Northumberland and Durham Local Authorities' Clean Air Committee, to be read at the committee's next meeting in Newcastle, on Thursday, December 7th.

" The whole of the Northern Gas Board's current production of British Standard specification open-fire coke—65,000 tons a year—can be switched to the domestic market when needed.

" With a potential local supply of over 100,000 tons a year (and without recourse to imports from the North-Western and

North-Eastern regions which would involve additional expenses) against a current consumption of about 6,000 tons in smoke control areas, it is clear that there is room for a considerable expansion of smoke control areas in the North East," the letter continues.

"The Ministry of Power will continue to keep the general supply and demand situation in the North East under review."

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BRIGHTON CONFERENCE

4th–6th October, 1961

Members and Delegates Attending and Authorities, etc., Represented

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List corrected to 20th September; for additions and alterations inquire at the Conference Office, Exhibition Hall

National Society for Clean Air

Brighton Conference, 1961

LIST OF MEMBERS AND DELEGATES ATTENDING

A

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B

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C

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Cohen, the Rt. Hon. Lord, of Birkenhead, (*see Conference Handbook*)
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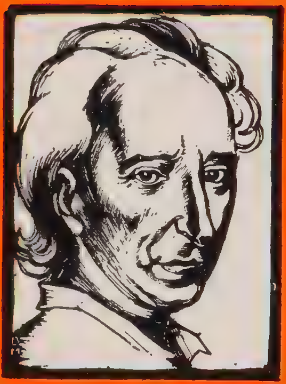
Clean Air Conference

Brighton — 4th – 6th October, 1961



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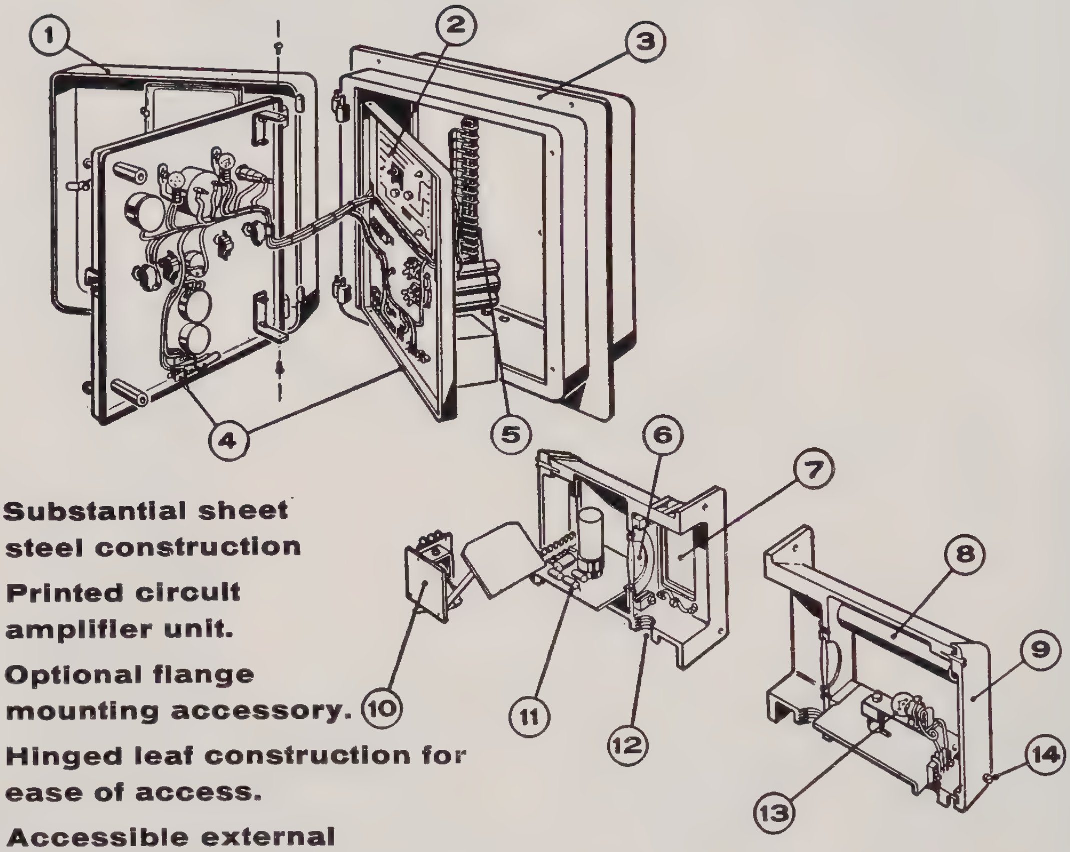

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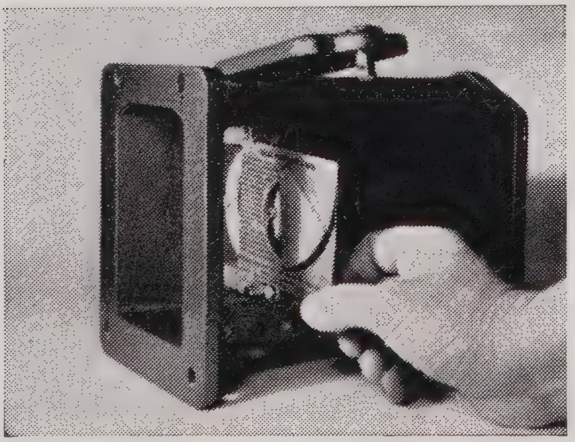

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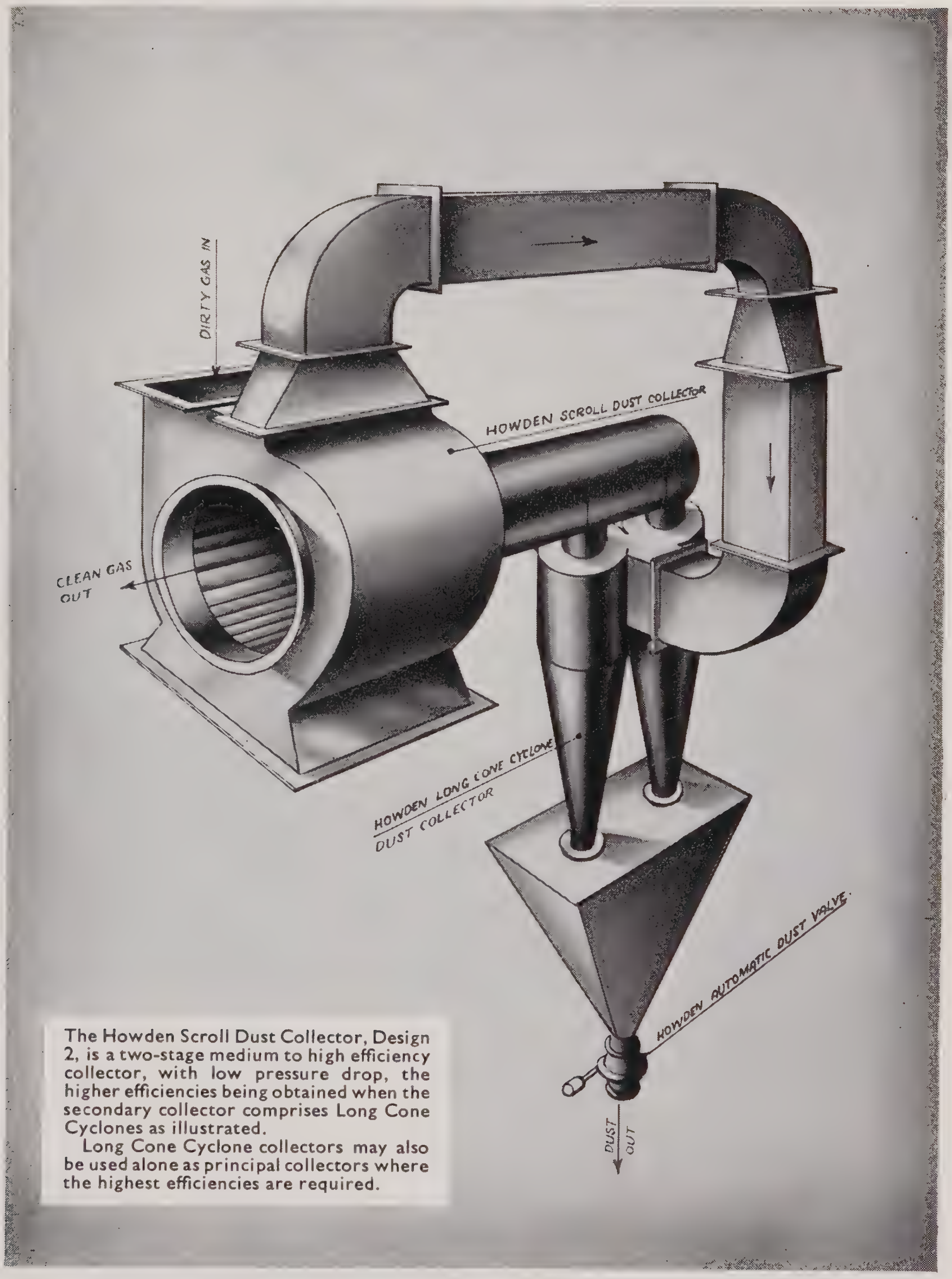
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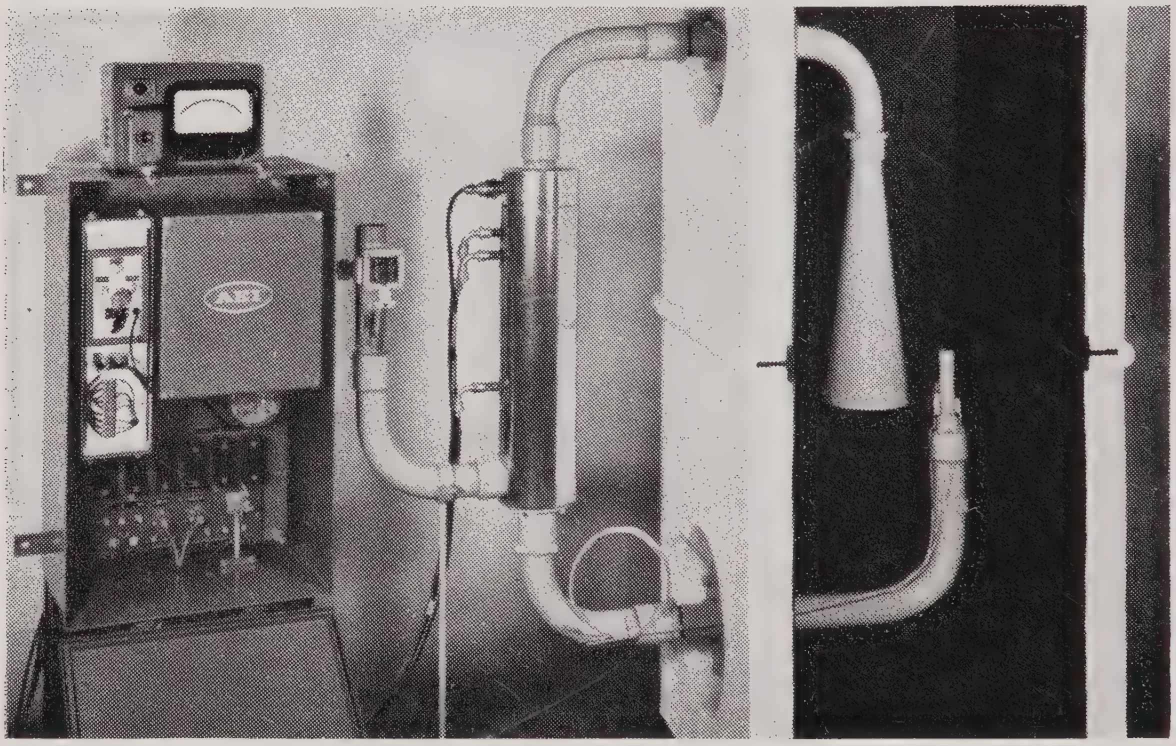

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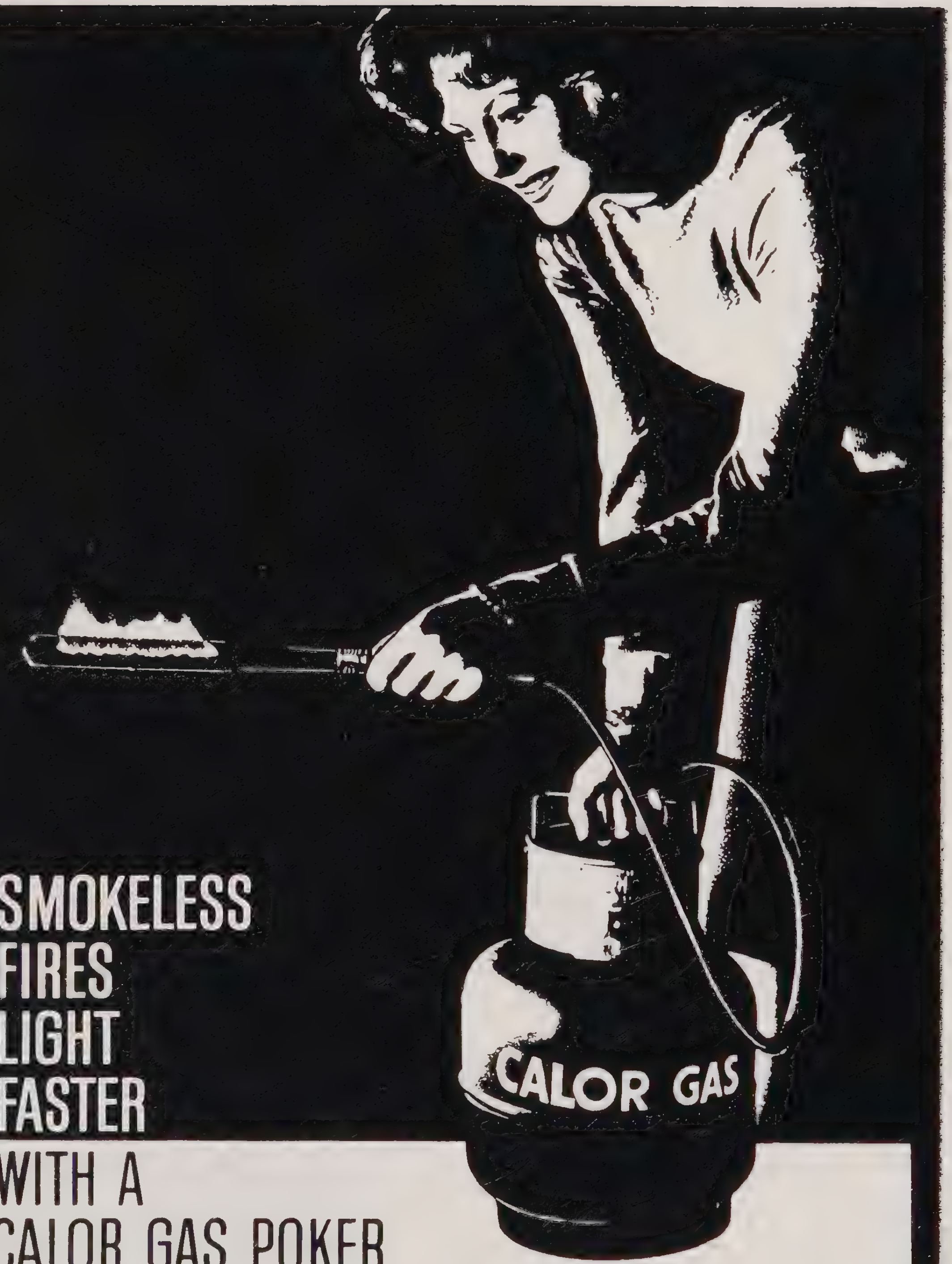

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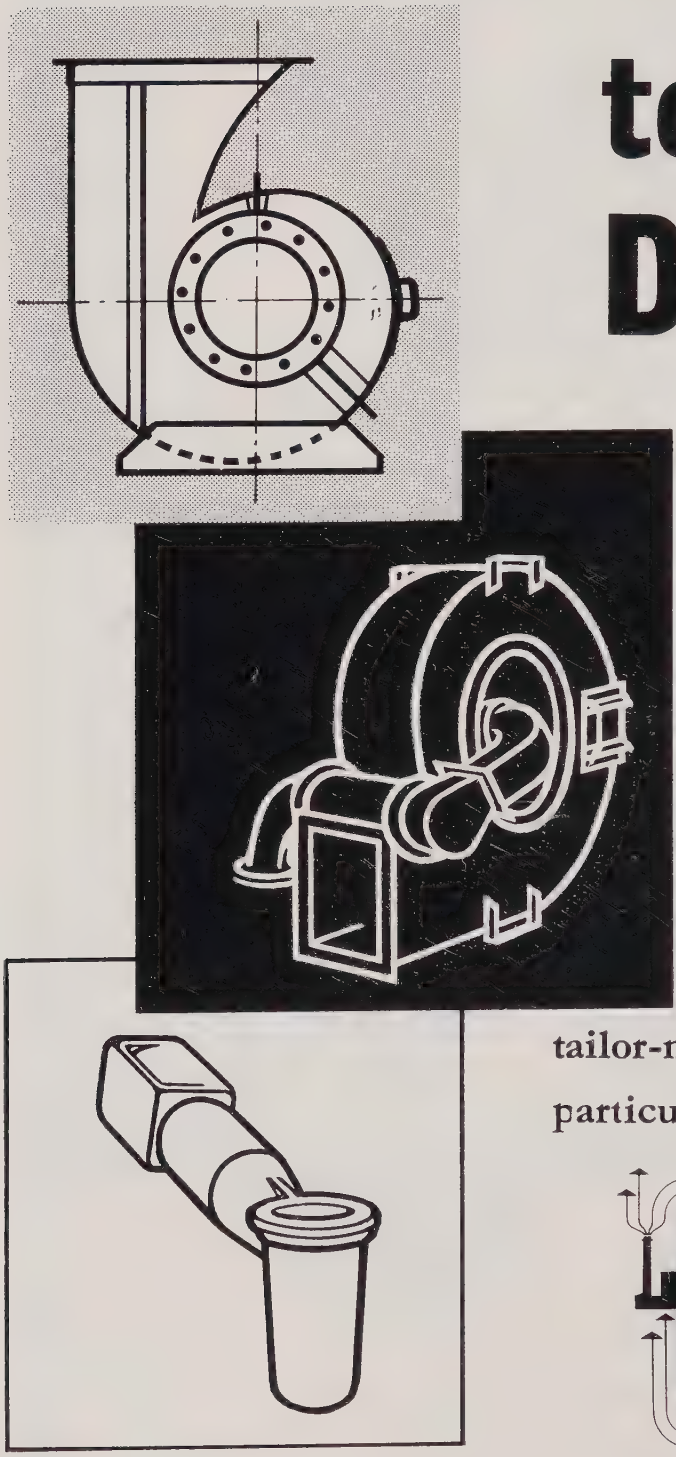

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National Society for Clean Air

28th Annual Conference and Exhibition
Brighton, 1961

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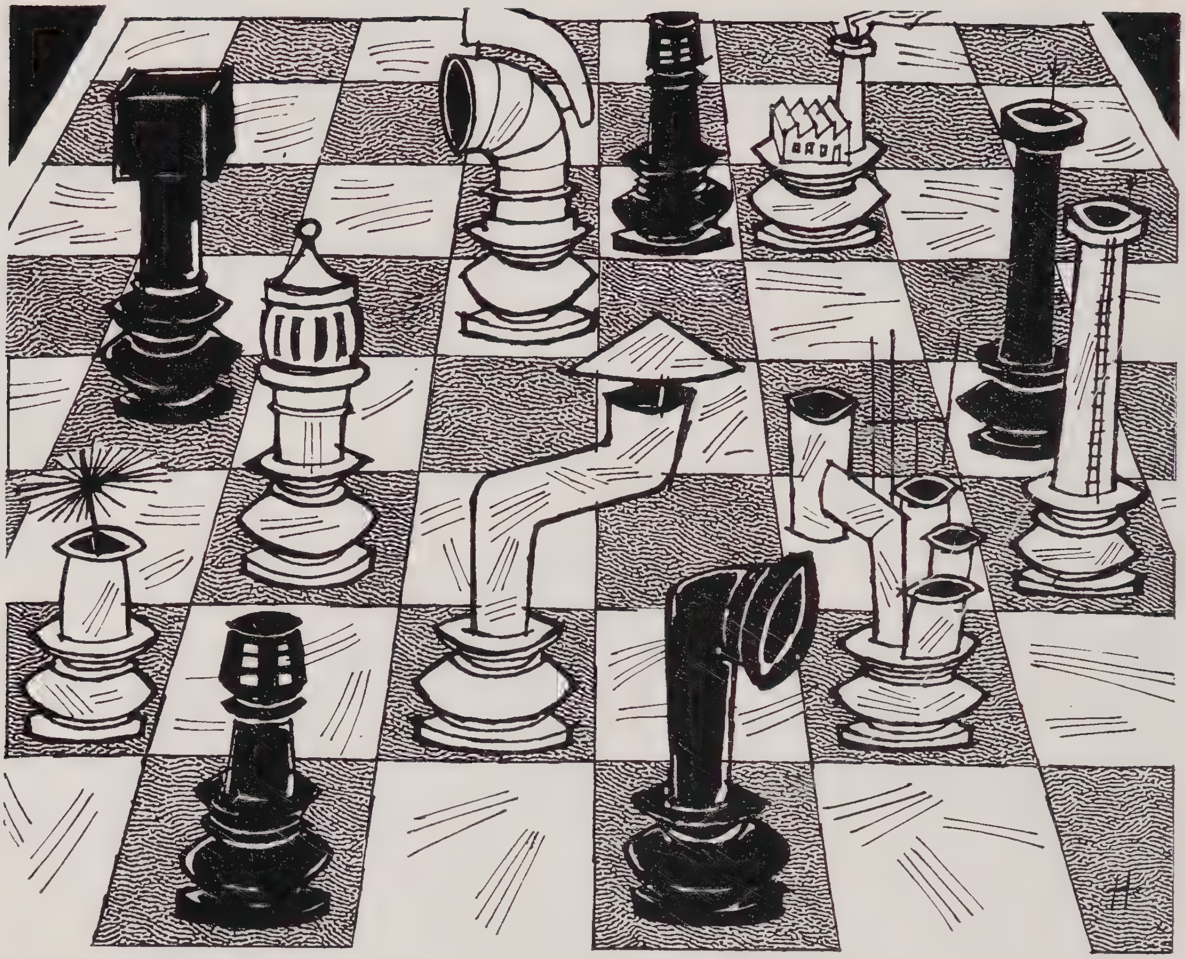

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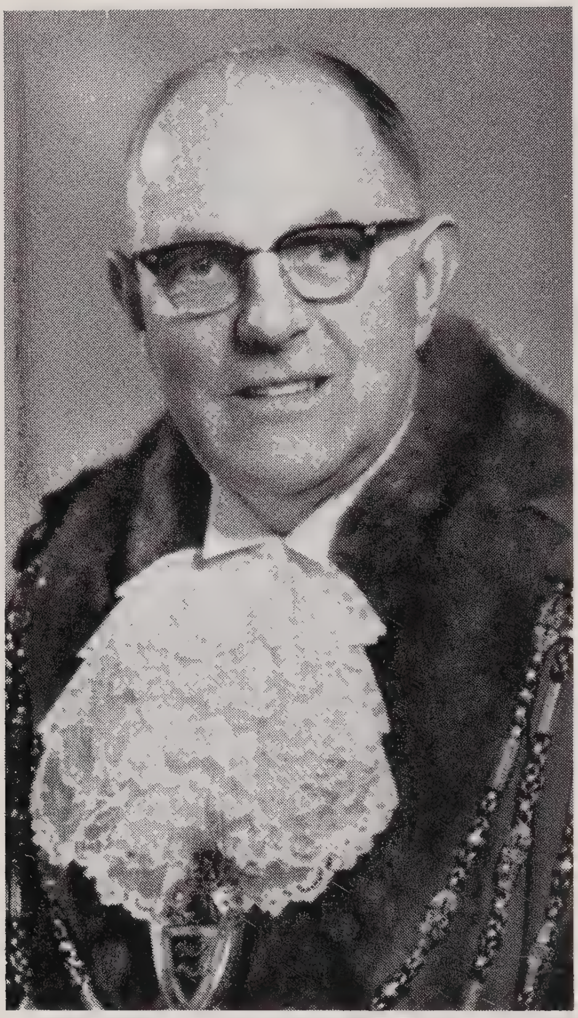


A message to the Conference from the Mayor of Brighton

The Mayoress and I will be looking forward with very much pleasure to meeting the members of the National Society for Clean Air when they visit Brighton in October.

The subject matter of the Conference is, of course, something which is of particular interest to me. As a former Chairman of our own Health Committee I naturally feel very much in sympathy with all that the Society is trying to do. I always read your publications with interest and recently had occasion to record my vote for the constitution of the Council. I shall be delighted to have the opportunity of welcoming so many people of common interest.

I hope very much that all the delegates and their ladies will find a little time from their conference duties to enjoy some of the celebrated air for which this popular resort is so famous. And I hope, too, that everyone who is here for the occasion will have a thoroughly pleasant and profitable visit.

G. B. Baldwin,
Mayor.

Notes on the Conference

MEMBERS and delegates who are familiar with the Society's conferences will no doubt have noted that the programme has been extended by a half day. We think that the value of the extra session on the Friday afternoon will be appreciated—especially as it will see one of the most important discussions of all.

Briefly, the main features of the conference will be the addresses by Mr. John George and Lord Cohen of Birkenhead on the Wednesday morning; two reports of special interest on the Wednesday afternoon; industrial pollution problems on Thursday, followed by the Transatlantic Linkup programme; and domestic heating, fuels and smoke control areas on Friday.

For the three evenings there is the informal "Get Together" on Tuesday, and the Royal Pavilion Receptions and Film Shows on the Wednesday and Thursday.

John C. George, C.B.E., M.P.
Parliamentary Secretary, Ministry of Power

The Sessions

At the opening session on Wednesday morning the Society's new President, Lord Cohen of Birkenhead, will be in the Chair, and his Presidential Address will follow the Civic Welcome by the Mayor of Brighton and the opening of the Conference and Exhibition by Mr. John C. George, C.B.E., M.P., Parliamentary Secretary, Ministry of Power.

Lord Cohen, as President of the Royal Society of Health, will already be known to many of the delegates. Mr. George is directly concerned with those aspects of clean air policy and the work of the Clean Air Council that are the concern of his Ministry.

On the Wednesday afternoon there will be a progress report from Warren Spring by Dr. Craxford and his colleagues on the important National Survey of air pollution now being organized. This will be followed by discussion on a report on the reception that has been given to the Society's proposals for a Bill for the Certification of Furnace Operators. This will be introduced by Mr. Sydney N. Duguid, and the discussion will provide a first opportunity of hearing the views of our members and delegates. After this there may also be, though at the time of writing it is not certain, a statement or resolution on pollution from road vehicles.

The two sessions on Thursday will be devoted to industrial air pollution—four papers and discussion in the forenoon, and in the afternoon questions to be answered by a panel of experts—if you have a question please send it in *before* the conference.

On Friday morning we turn to domestic problems, with a comprehensive paper by Mr. W. F. B. Shaw of Warren Spring on new methods and systems of space heating in the home. Mr. Shaw edited, and wrote several chapters of, the recent book, *Domestic Heating*. Then in the afternoon the final session of the conference will come to smoke control area progress, with a challenging paper by Mr. Herrick of Fulham, followed by a review of the solid smokeless fuels position. This has been prepared by the Solid Smokeless Fuels Federation, and on the platform, ready for anything that may come, will be a panel of representatives of all the solid smokeless fuels—plus spokesmen for electricity, gas and oil for any questions outside the solid fuel range. The session, and the conference itself, will end with the moving of any resolutions that may have been sent in and accepted, and the customary general votes of thanks.

The Transatlantic Linkup

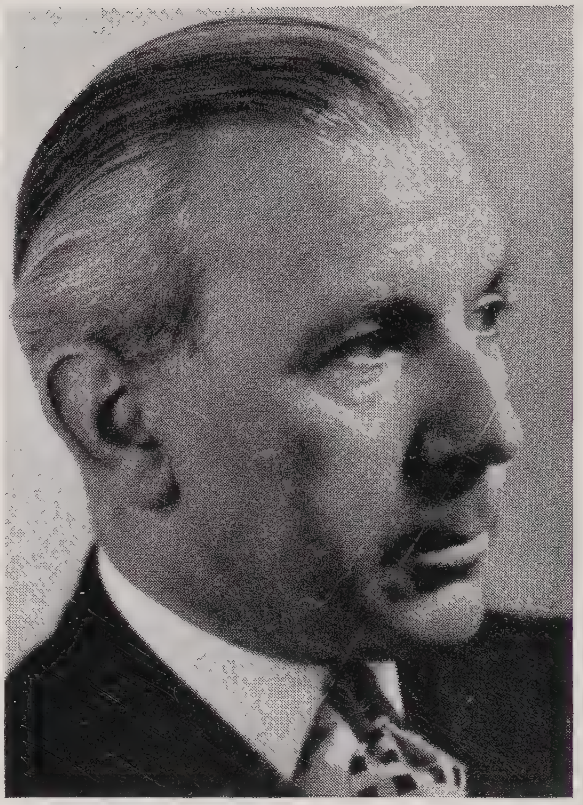
The most novel feature of the conference will be the discussion, over high-fidelity telephone cable, between a panel on the platform at Brighton and one in the U.S.A. Such a discussion has been featured in other conferences and has proved to be most successful. It will begin immediately after the ordinary Thursday afternoon session.

The U.S. team are members of the Air Pollution Control Association of America, and their photographs are given on another page. There will be enlargements of these on the platform during the programme, each member being spot-lighted as he speaks.

The cost of this feature was more than the Society could itself manage, and we are most grateful to the well-known pharmaceutical firm of Pfizer Ltd. for having most generously undertaken to sponsor it for us. More than that, they are also coming into the exhibition with what will be an outstandingly interesting stand.

The Exhibition

The Clean Air Exhibition at Harrogate last year was given much praise, both to the Society for its organization and general design, and to the exhibitors for the high quality and interest of their stands. From what we have learned of exhibitors' intentions for Brighton an even better show may be anticipated. No delegate should miss the exhibition—and a detailed tour or tours of inspection, rather than a quick run round, is recommended. There will be much to see.



The Rt. Hon. Lord Cohen of Birkenhead, *President*

The Bookstall

Delegates are invited to inspect and patronize the Society's bookstall, at which publications may be purchased or ordered. (Every sale assists the Society!) Our own new publications include the Harrogate, 1960, Conference *Proceedings*, the Tercentenary Edition of John Evelyn's *Fumifugium* (not to be missed), the new leaflet *Clean Air Begins at Home*, and the new Publicity Advisory Service catalogue.

Other publications available will

include Shaw's *Domestic Heating*, the latest Alkali Works report, and all other Government publications relating to clean air.

On other Pages

Elsewhere in this handbook will be found the detailed programmes, information, particulars of the authors and other platform people, the programmes for the Film shows, and of course the Exhibition catalogue. A special feature is the account, by Mr. Clifford Musgrave, Director of the Royal Pavilion, of the fascinating history of the Pavilion and the Dome. The progress of the Society and of the clean air movement generally since the end of the war is indicated in the review of the 1956 conference, which it is hoped will be of interest especially to those who were not present on that occasion.

Fifteen Years Ago

The Society's First Brighton Conference

THE first full conference of the Society to be held after the war was at Brighton in October 1946. Ending a seven year break, it was a sign of a new era that the attendance of 400 should have been nearly double the pre-war figure. But it was still small enough for the meetings to be held in the Music Room of the Royal Pavilion.

It was an important conference in that it brought into debate, and to the notice of the many local authorities who were represented for the first time, the new ideas and proposals for smoke prevention that the Society had been developing. Although it had held hardly any meetings, the war years had been far from empty for the Society, and it had been mostly by the typed or printed word that it had been promoting new policies for clean air and had been emphasizing its importance in the nation's plans for reconstruction and for fuel and power. The Brighton conference brought this work before the many new delegates, industry and the government departments. It is not too much to say that the conference was one of the foundation stones on which, in due course, was to be built the Beaver Report and the Clean Air Act.

The conference opened with the reading of a goodwill message from the Lord President of the Council, the then Rt. Hon. Herbert Morrison, and with a Presidential Address by Sir George Elliston. The main subjects of the papers and discussions that followed were, even as in 1961, the problems of domestic and industrial pollution. But the contents both of the papers and of the discussions show what advances have been made during the last fifteen years.

The session on domestic smoke control was based on reports presented by the Regional smoke abatement committees of the local authorities (the Society had only one Divisional Council at that time) on a questionnaire sent by them to their constituent members. The questionnaire, drawn up by the Society, was an attempt to discover what the authorities were doing, or were planning to do, in making new houses and flats either smokeless or (by the use of the new improved grates) capable of smokelessness, and what was being considered with gas, electricity, central and district heating, heat insulation, etc. The replies, for the most part, were promising—but not more. It was evident that much needed to be done to make the authorities, architects and builders fully aware of what could and should be done.

The industrial pollution session dealt with proposals for new legislation made by the Society, including one factor on which progress has still to be made—the certification of furnace operators. One of the four papers presented overshadowed the others by reason of its length and detail and the counter-proposals it put forward, and which created a controversy that continued long after the conference was over. It was by Mr. T. A. Humphreys, representing industrial organizations, and in brief he suggested that smoke abatement legislation should be taken from the sphere of local government and be administered by Regional Smoke Abatement Officers of the Ministry of Fuel and Power (as it then was). He also dismissed the idea of smokeless zones and maintained that the only remedy for domestic smoke was " drastic reforms in methods of burning raw coal ". Nevertheless he did make forward-looking suggestions that are in line with present day practice or intention, as on the height of chimneys and the compulsory use of measuring and recording instruments.

The final paper, entitled " What of the Future? " was a constructive and inspiring address by Charles Gandy, Chairman of the Society's Executive Council. He outlined a policy for the Society to pursue and appealed to the Government departments concerned to end their indifference to smoke abatement. After referring to the increasing public concern about air pollution he said:

> " The country is ready for the great attack to begin in earnest. Where then are the preparations for it? Where the central organization and driving force which should be behind it all? At present, it is not as one might have hoped the Government, but the National Smoke Abatement Society alone which is the connecting centre for this nation-wide resolve to have done with a nation-wide evil. . . ."

Resolutions

A record number of five resolutions were proposed and carried at the end of the conference, and it is interesting to note their subject matter.

The first expressed concern about pollution from electricity generating stations and called for steps to be taken to obviate the nuisance.

The second urged a higher priority for the production of the new improved appliances for the use of solid smokeless fuel in the home, and asked that " the payment of subsidy to housing authorities be conditional on the installation of such appliances as soon as they are available ".

The third extended the good wishes of the conference to the newly established National Coal Board and said it was " gratified to learn that progressively increasing production of smokeless fuels is to be in the forefront of its programme ".

The fourth endorsed the appeal made in his Presidential Address by Sir George Elliston to all non-member local authorities " to add their strength to the campaign against the nation-wide evil of smoke by becoming members ", and the fifth approved in principle the proposals for new industrial smoke prevention legislation, and asked the Executive to consider these further in the light of the discussions and to take appropriate action.

There was a Reception in the Royal Pavilion during the conference which, after the lack of social contact during the grey war years was wonderfully heartening and set the seal on the success of a conference that started the Society on the road of growth and success along which it has since continued to travel.

We return to Brighton with two Receptions in the Royal Pavilion, requiring the Dome for the meetings instead of the Music Room, and with a large and important Exhibition instead of a six-foot bookstall.

Brighton and the Royal Pavilion

by

*Clifford Musgrave, O.B.E.**

IN the middle of the eighteenth century the quiet little fishing town of Brighton already possessed the great natural attractions of brilliant exhilarating air, long hours of dazzling sunshine, and the beauty of the encircling Sussex countryside with its rolling green-backed downs. The town quickly blossomed into a fashionable seaside resort when the sea-water treatment for diseases of the glands, which was advocated by the famous Dr. Richard Russell, became popular, and people flocked to the seaside for the sea-bathing, and even to drink what was called " the oceanic fluid ".

It was the gaiety and elegance of Brighton that attracted the young Prince of Wales, George, in 1783, when in September, always one of the town's loveliest months, having just achieved his majority, he decided to escape from the oppressive Germanic authority of his father King George III.

The house the Prince rented in the following year, though then a simple traditional Sussex farmhouse, was to become during the next thirty-five years transformed into a palace, and one of the most celebrated and remarkable architectural wonders of the world, yet through all this time, to within a few years of his death, it was to be his home for several months each summer. To this farmhouse, some called it a cottage, the Prince brought in 1786 the beautiful Mrs. Fitzherbert, whom he had wedded in secret the year before. For a number of seasons they lived here a life of idyllic delight, and in 1787 the building was enlarged by the Prince's architect Henry Holland, to give it the form of a classical villa.

The " Marine Pavilion ", as it then became known, retained this charming unpretentious shape until 1815, and during these years the building was the setting for the Prince's little court which included some of the wittiest and most intelligent as well as some of the wildest spirits of the day. There were the rakish Barrymore family, and the hard-driving Lades, but also the Prince's idolized friend, Charles James Fox, brilliant leader of the Whigs, and their great orator, the mercurial and unpredictable Sheridan, author of " The Critics " and " The School for Scandal ". Byron, too, was a visitor to the Pavilion in its early days.

The gaiety of life at the Pavilion was clouded over towards the end of the century by the Prince's luckless state wedding to Princess Caroline of Brunswick and through his succumbing to the spells of the vixenish Lady Jersey, but by 1800 he had left both these ladies and had become reconciled to Mrs. Fitzherbert, and a new idyllic episode opened at Brighton. To celebrate this new phase of delight, in 1802 the Prince ordered the whole interior of the Pavilion to be transformed with a Chinese scheme of decoration, with painted wallpapers, lacquered pillars, golden dragons, porcelain model junks, banners and furniture of lacquer and bamboo. " The Chinese Taste " in furniture and

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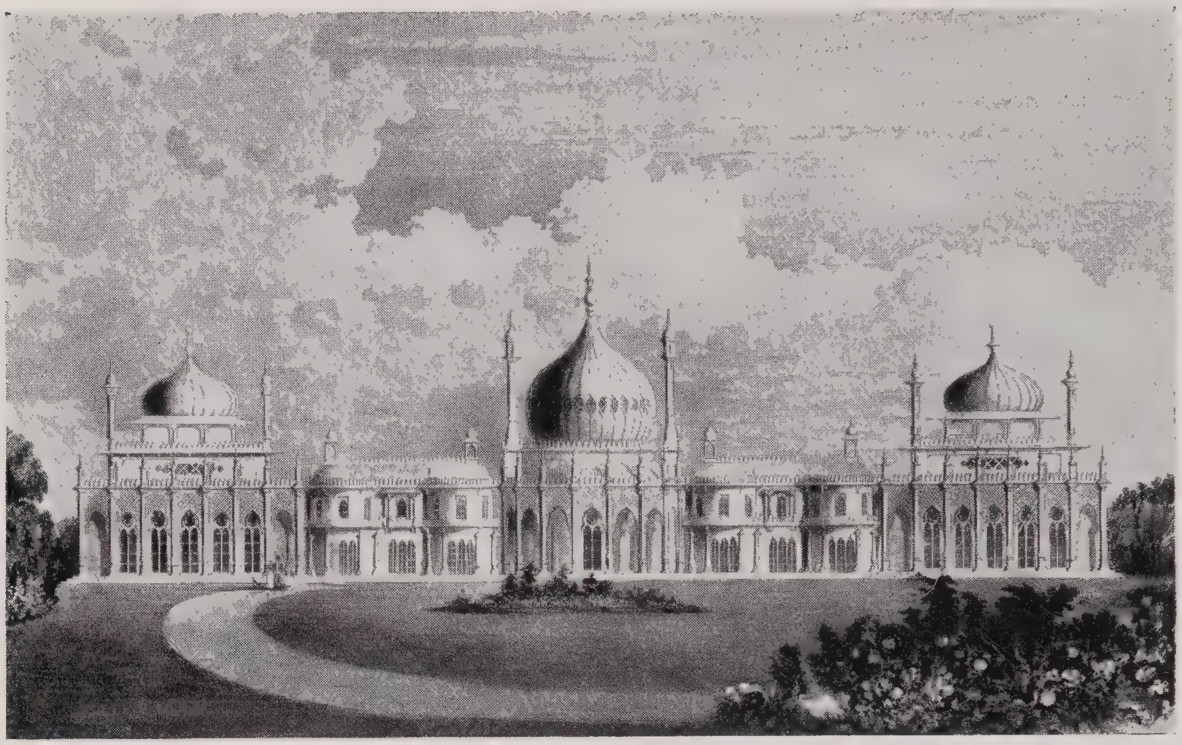
* Director, Royal Pavilion Estate, Brighton



Nash's first design for the east front of the Royal Pavilion, 1815

decoration was not new: almost every great house at that time had its Chinese room, with " Chinese Chippendale " furniture, and porcelain from the Far East, as did the Prince himself at Carlton House, but never before had this fashion been indulged in with such vivid exuberance. China had been a kind of wonderland to European artists and architects, but soon it was to be eclipsed by the mysterious, newly developed land of India, which offered new rich poetic possibilities in those early days of the Romantic movement. Accordingly the Prince built the magnificent Royal Stables (now the Dome) in the style of the palaces of the Moghul princes of India.

The Dome (*Royal Stables*) *and Corn Exchange* (*Riding House*)

The dome of the Stables, 80 feet in diameter and 65 feet in height, was modelled upon that of the Halle au Blé (Corn Market) in Paris, and was a remarkable engineering structure for its day. Round the great circle of the walls were 44 boxes for horses, and there was an arcaded gallery which contained rooms for the stable servants. In the centre of the building stood a fountain. Adjoining was a vast Riding House, 175 feet long, where the Prince could take exercise in private or in bad weather, or try the paces of a new horse.

The cost of the Royal Stables, together with the Riding House, amounted up to the time of its completion in 1808 to £54,783 12s. 5d.

The Entrance Porch in the Pavilion Grounds was added in 1901-2, but it is dignified and well-proportioned, though lacking in the grace and fantasy of the original architecture.

In 1935 the interior of the Dome was completely remodelled, the present false ceiling being then introduced. The building has become one of the finest concert halls of the country and is frequently visited by famous orchestras and well-known soloists, as well as being used for great conferences.

During Victorian times, and indeed up to 1914, the Riding House was used as a Corn Exchange, and is still known by this name. The interior, although having modern decorations, still retains much of the original structure of walls, arched windows and timber roof, and is much used for banquets, exhibitions, dancing and displays.

In 1815, having become Prince Regent in 1811, he appointed as his architect John Nash, the creator of Regent Street and the Regent's Park Terraces, and carried out enlargements of the Pavilion into the shape we see it today, with its innumerable domes, minarets, lattice screens and fretted balconies in the Indian style. The interior remained Chinese, but of a brilliant undreamed-of fantastic grandeur. The Music Room, with its serpents entwined round columns, its dome of gold, crimson wall-paintings and roofs of bamboo-cane, reproduced Marco Polo's description of the palace of the Tartar Emperor Khubla Khan at Xanadu, and in 1816, as the Pavilion took on its final oriental shape, the romantic poet Coleridge wrote those magic lines that open upon the most fantastic dream-landscape in literature, "In Xanadu did Khubla Khan a stately pleasure dome decree . . .".

The Pavilion was completed soon after the Prince Regent's coronation as King George IV in 1821, an event that marked the building's transformation from a sea-bathing pavilion to the palace of a monarch.

After the death of King George IV, King William IV and Queen Adelaide lived at the Pavilion in royal magnificence for a few years, but their successor, Queen Victoria, found the extravagance of the place and its lack of privacy distasteful, so the building was sold to the townspeople of Brighton for £50,000—it had cost well over half-a-million.

Believing that the building was to be demolished, Queen Victoria had all the fantastic oriental decorations and furnishings removed, to enable her to furnish Buckingham Palace, then recently completed, economically, but a number of chandeliers and wall-paintings were returned by her later.

In recent times Her Majesty the Queen has returned from Buckingham Palace and Windsor Castle over a hundred articles of the original furniture of bamboo and lacquer, and of Chinese porcelain.

The State Apartments have now almost entirely been restored to their appearance at the time of their

The Steine, by Spornberg, 1798

The Dome, today

completion for King George IV, with their fantastic oriental wall-decorations, carved and gilded dragons, Chinese porcelain pagodas, and immense glittering chandeliers. Each summer the rooms are opened for inspection by the public, filled with furniture and works of art of the period when this fantastic holiday retreat came into being.

But the Royal Pavilion is more than the relic of an eccentric monarch. In the way it embodies the outlook and moods of the Regency period it becomes a symbol of one of the greatest ages in our history, the age of Byron, Coleridge, Keats and Shelley, of Nelson and Wellington. Above all it is, in its harmonious proportions and in the subtlety and grace of its dome, minarets and arches, a creation of fabulous beauty, speaking forever of worlds of fantasy and romance.

Clifford Musgrave

National Society for Clean Air

formerly the

National Smoke Abatement Society

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For New Delegates

ABOUT THE SOCIETY

Those who are attending the Conference for the first time may wish to know more about the National Society for Clean Air. As we celebrated our Diamond Jubilee in 1959 with a special International Conference it will be seen that the Society has quite a long history. Starting in a very small way with but a handful of private individuals, the Coal Smoke Abatement Society was formed in 1899. It did valuable pioneering work and accomplished the first necessary stage of making it understood that clean air was not the impractical fad of a few cranks. It did much behind the scenes when the Newton Committee (mentioned on another page) was set up, and co-operated with a provincial association that had been formed in 1909, the Smoke Abatement League of Great Britain. In 1929 the two bodies joined together to form the National Smoke Abatement Society.

This name was retained until 1958, when it was changed to the present one, and at the same time, to put its membership and finances on a recognized business footing, it became a Company Limited by Guarantee and not having a share capital. It is licensed by the Board of Trade to omit the word " Limited " from its name and for Income Tax purposes it is recognized by the Board of Inland Revenue as a Charity.

The Society is a voluntary organization essentially subsisting on the subscriptions of its members, and it does not receive any official grant or subsidy. Its members include individuals, local authorities and firms, associations and other corporate bodies. Although local authorities—over 500—constitute the largest class of membership the corporate members make the largest class of subscriptions. The Society is governed by an Executive Council consisting partly of elected representatives of members on a divisional basis, and partly of the appointed representatives of national organizations in membership. The Divisions are Scotland, North West, North East, Yorkshire, West Midlands North East, Yorkshire, West Midlands, East Midlands, South East, South Wales and Monmouthshire, South West and Northern Ireland. There are Divisional Councils of members, with their own committees and honorary officers, in each of the Divisions except the last two.

The Society's objects are, in brief, to promote clean air by education, publicity and similar means, to encourage the adoption of means for clean air, and generally to help to create a public opinion in favour of these objects. Its main activities are the publication of a journal, Year Book and other literature, the holding of conferences and meetings, providing educational and publicity material, information and other services, and co-operating with others.

The Society and its parent bodies have many achievements to their credit, from pioneering the training of boilerhouse firemen and the regular measurement of air pollution to the conception and advocacy of smokeless zones and prior approval.

Today, with the new Act in force, the opportunities for useful activity by the Society are greater than ever before, and are in fact both needed and demanded more than ever before. But much remains undone because its income is only a tithe of what could be used to advantage. New members, and more new members, are needed—and if you, as a delegate to this conference, can help us to secure them you will be doing a very good turn to the cause of clean air.

Conference Information

Meeting Places

All Conference sessions will be held in the Dome; the Civic Receptions will be held in the Royal Pavilion; and the Film shows will now be held in the Dome and *not*, as originally announced, in the Pavilion Theatre.

Informal Gathering

The informal gathering or " get together " of members and delegates will take place at the Hotel Metropole on Tuesday evening, October 3rd, from 8 p.m. *Please use the Cannon Place entrance, on the right-hand side of the hotel.* There will be no formalities or programme.

Registration

A Registration Card will be enclosed with this Handbook, and you are requested to complete this and hand it in at the Society's Information Desk, or to a Steward, at the first session attended.

Discussions

Those wishing to speak in the discussions should complete and hand in a printed Discussion Card which may be obtained from the Society's stand or Steward in the hall. All speakers are requested to: (*a*) condense their remarks as much as possible, and (*b*) confine them to the specific questions raised in the papers being discussed. The time allowed for contributions will normally be limited to three minutes. Those who take part in the discussions and wish to have their remarks recorded are asked to send a condensed copy of their remarks, in reported speech, to the Director not later than October 17th.

Resolutions

The following conditions for the submission of resolution are stipulated by the Executive Council:

(*a*) Any resolution it is desired to submit must be relevant to matters under discussion at the conference.
(*b*) No resolution may be moved except by prior approval of the Resolutions Committee.
(*c*) A copy of the proposed resolution must be received by the Director not later than 10.30 a.m. on Wednesday, October 5th, or preferably by post (at the Society's offices) on or before September 30th.
(*d*) Resolutions will be moved at the end of the Friday morning session only.

List of Delegates

A printed list of delegates will be available at the Society's stand in the Exhibition.

Proceedings

All the Papers, Addresses, discussions and any resolutions adopted will be published in volume form as the *Proceedings* of the Conference. A copy will be forwarded free of charge to all registered delegates and extra copies will be available at about 25s. each.

The Exhibition

The Clean Air Exhibition, organized by the Society in conjunction with the Conference, will be held in the Corn Exchange and in an adjoining Frame Tent, adjacent to the Dome. The Exhibition will be open from 9.30 a.m. to 5.30 p.m. on the Wednesday and Thursday, and to 5 p.m. on the Friday. Admission will be free to all delegates.

Conference Club

Registration as a delegate includes membership of the Conference Club, adjoining the Corn Exchange Exhibition. A membership ticket, which will be required for admission, will be enclosed with this Handbook to delegates. Light refreshments and drinks will be available throughout the day.

Bookstall

There will be a bookstall of the Society's, H.M. Stationery Office and other publications as a part of the Society's Stand in the Exhibition.

Bank Facilities

Full banking facilities will be available to all attending the Conference or Exhibition, from the District Bank Ltd., at Stand F.1 in the Exhibition.

Postal Facilities

Postal facilities will be available in the foyer, Church Street entrance, of the Corn Exchange.

Rail Travel

Inquiries about rail travel, seat reservations, etc., may be made at the British Railways Bureau, Stand H.4 in the Exhibition.

General Inquiries

The Society's staff at the Conference Office (see Exhibition plan) will be pleased to assist with any inquiries on matters not mentioned above.

Previous Conferences of the Society

1929	Buxton
1930	Leicester
1931	Liverpool
1932	Newcastle-upon-Tyne
1933	Sheffield
1934	Glasgow
1935	Bristol
1936	London (Science Museum)
1937	Leeds
1938	Cardiff
1943	London*
1945	London*
1946	Brighton*
1947	Edinburgh*
1948	Cheltenham*
1949	Harrogate*
1950	Margate*
1951	Blackpool
1952	Portsmouth*
1953	Glasgow*
1954	Scarborough*
1955	Bournemouth
1956	Southport*
1957	Hastings*
1958	Llandudno*
1959	London (Diamond Jubilee International)*
1960	Harrogate*

** Proceedings still available. For prices and other details see current Clean Air Year Book.*

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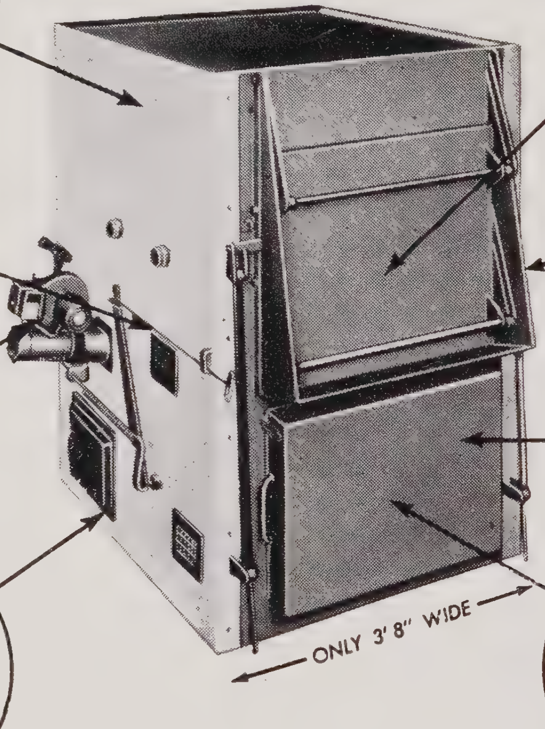

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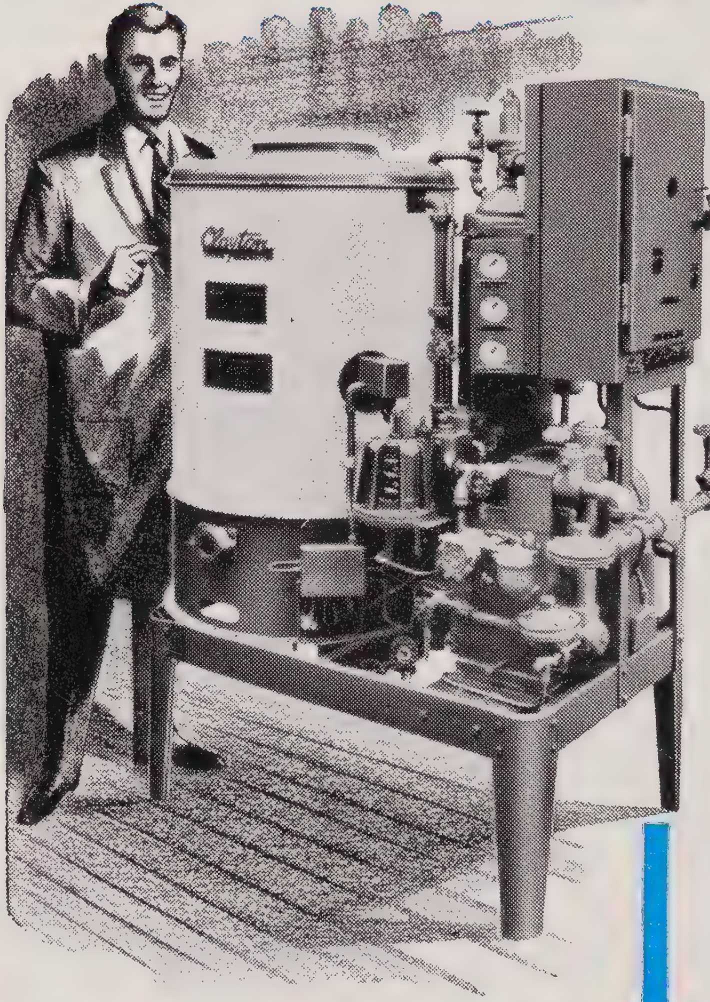

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For heating, processing and other auxiliary services Clayton steam generators give:—

- ★ **reduced fuel costs**
- ★ **immediate automatic operation from manual cold start**
- ★ **full operating pressure in less than five minutes**
- ★ **automatic adjustment to meet all steam requirements**
- ★ **maximum safety and require minimum maintenance with easy servicing.**

Clayton steam generators are available with capacities ranging from 430 lb/hr. to 4,600 lb/hr. from 60°F. Generators with capacities of 1,450 lb/hr. to 4,600 lb/hr. can be supplied for firing by fuel oil of 220 or 950 secs. viscosity (Redwood No. 1).

Technical Publication available on request

Clayton

STEAM GENERATORS

THE VULCAN FOUNDRY LIMITED, NEWTON-LE-WILLOWS, LANCASHIRE

Telephone: Newton-le-Willows 3641

Member of the English Electric Group of Companies

VFC. 7

Platform Who's Who

Arch, Arnold. Executive Secretary, Air Pollution Control Association of America; Senior Fellow, Mellon Institute, Pittsburgh; Formerly Air Pollution Control Director, Niagara Falls; Holds rank of Lt.-Col. in Army Reserve.

Baird, David E., M.I.Min.E., T.D. Director, British Coking Industry Association; Member of Executive Committee, Solid Smokeless Fuels Federation.

Baldwin, Councillor G. B., J.P. Mayor of Brighton. (See also page 14.)

Barratt, J. Manager, Inland Branch, Marketing Department, National Coal Board.

Batey, J. W., D.P.A., M.I.Mar.E., M.R.S.H. Superintendent Smoke Inspector, Sheffield and District Clean Air Committee.

Beaver, Sir Hugh, K.B.E., LL.D. Immediate Past-President, N.S.C.A.; Chairman of the Government Committee on Air Pollution, 1953; Member of Clean Air Council.

Bernard, J. I., M.I.E.E. Director and Secretary, British Electrical Development Association; Member of Executive Council, N.S.C.A.

Burn, J. L., M.D., D.Hy., D.P.H. Medical Officer of Health, Salford; Joint Deputy Chairman of Executive Council, N.S.C.A.

Clifton, Marjorie, M.D. Warren Spring Laboratory, D.S.I.R.; Now organizing the National Survey of Air Pollution; Formerly engaged on air pollution research in Sheffield for Medical Research Council.

Cohen, the Rt. Hon. Lord, of Birkenhead. President, N.S.C.A.; Professor of Medicine, University of Liverpool; Chairman, Central Health Services Council, Ministry of Health; Member of Clean Air Council; President, Royal Society of Health.

Cohen, Stanley E., C.C., F.R.S.H. Hon. Treasurer, N.S.C.A.; Chairman, City and Port of London Health Committee; Member, Clean Air Council.

Cooke, J. O., B.Sc., M.I.Mech.E., A.M.I.E.E., A.M.I.Gas E., M.Inst.F. Manager, Coke Department, Gas Council; Member of Executive Council, N.S.C.A.

Craxford, S. R., M.A., D.Phil. Head of Atmospheric Pollution Division, Warren Spring Laboratory, D.S.I.R.

Dickie, W. J., A.M.I.Mech.E., M.Inst.F. Technical Officer, Federation of British Industries.

Draper, P., M.I.Mech.E., A.M.I.Mar.E., F.Inst.P. Technical Department, Shell-Mex and B.P. Ltd.

Duguid, Sydney N., B.Sc.Tech., F.R.S.H., F.Inst.F., J.P. Past-Chairman and Member, N.S.C.A.; Chairman, City and Guilds of London Institute's Advisory Committee on Boiler House Practice.

Eaton, F. J., B.Sc., Ph.D., A.R.I.C., M.Inst.Gas E. Deputy Manager, Watson House, The Gas Council; Member, Executive Council, N.S.C.A.

Faith, Dr. W. L. President, Air Pollution Control Association of America; Managing Director of Air Pollution Foundation, California, until its liquidation.

George, John, C.B.E., M.P. Parliamentary Secretary, Ministry of Power; Member of Parliament for Pollock.

Giblin, H. Manager, Solid Smokeless Fuels Federation.

Godson, R. J., M.A., Commercial Manager, British Coking Industry Association.

Goodfellow, James, F.R.S.H., M.I.P.H.E. Chief Public Health Inspector, Leeds; Joint Deputy Chairman of Executive Council, N.S.C.A.; Hon. Secretary, Yorkshire Division, N.S.C.A.

Haines, H. A., T.D., B.Sc., A.M.I.Mech.E., A.M.I.E.E., F.Inst.F. Area Engineer, London and South-Eastern Area, National Industrial Fuel Efficiency Service.

Herrick, G. W., D.P.A., F.A.P.H.I. Ollett Gold Medallist; Chief Public Health Inspector, Metropolitan Borough of Fulham; Hon. Secretary, Metropolitan Boroughs Chief Public Health Inspectors' Committee.

Innes, John, M.B.E. Chief Sanitary Inspector, Paisley; Chairman of Executive Council, N.S.C.A. and President of Scottish Division; Member, Clean Air Council for Scotland.

Lawther, Dr. Patrick J., M.B., M.R.C.P. Head of Atmospheric Pollution Research Unit, Medical Research Council, St. Bartholomew's Hospital.

Lister, D., F.R.S.H., F.A.P.H.I. County Health Inspector, Northumberland; Author of monographs on air pollution from road vehicles.

Marsh, Arnold, O.B.E., M.Sc.Tech., M.Inst.F. Director and Secretary, N.S.C.A. and Editor, *Smokeless Air*.

Opie, C. M., M.Inst.F., M.R.S.H. M.Inst.F. Director and Secretary Fuel Efficiency Service.

Parker, Albert, C.B.E., D.Sc., M.I.Chem.E., M.Inst.Gas E., F.R.S.H. Consultant; Formerly Director of Fuel Research, D.S.I.R.; Member, Executive Council, N.S.C.A.

Prindle, Richard A., M.D. Medical Director and Chief, Air Pollution Medical Programme, U.S. Public Health Services.

Shaw, W. F. B., B.A. Warren Spring Laboratory, D.S.I.R.; Formerly Chief Physicist, in charge of Domestic Heating Research, Fuel Research Station, D.S.I.R.

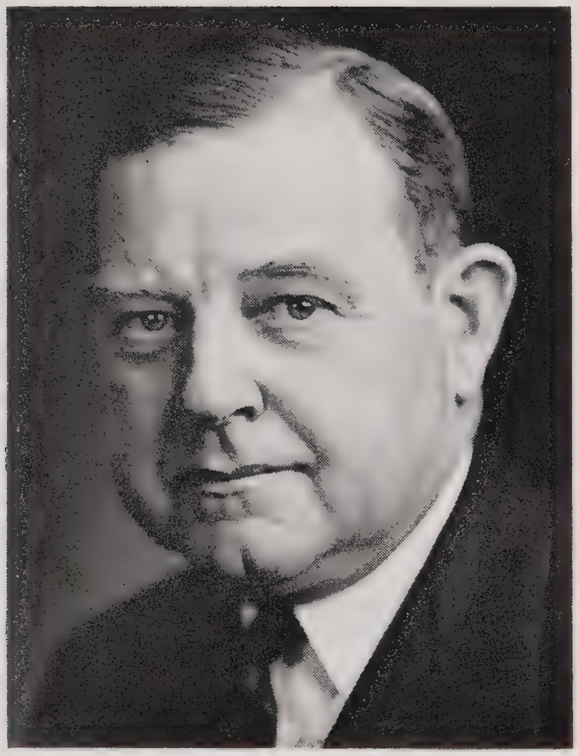
Waring, F. L., F.Inst.F. Managing Director, Coalite and Chemical Products Ltd.

Weatherley, Mrs. M.-L.P.M., M.A. Warren Spring Laboratory, D.S.I.R.; Engaged on the National Survey, microsurveys of smoke concentrations and dispersion of chimney gases.

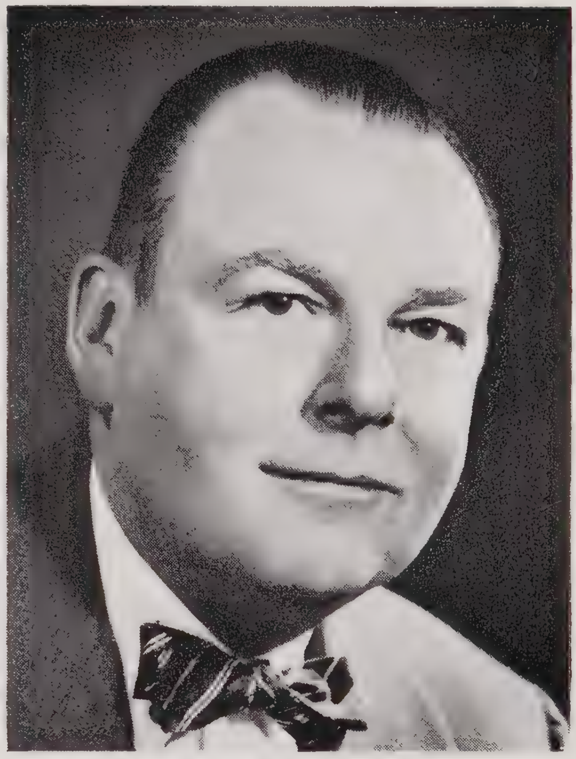
Webber, Arthur Frederick, B.Sc., M.I.Mech.E., A.M.I.E.E., F.Inst.F. Partner, Webber and Varlow, Consulting Engineers; Representing the Combustion Engineering Association.

Weidlein, Edward Ray, D.Sc. Chairman, Air Pollution Control Association of America; Scientist, author and retired President, Mellon Institute, Pittsburgh; Member, Allegheny County Smoke Control Advisory Committee and of Advisory Board of Health, City of Pittsburgh.

Transatlantic Link
The U.S. Team

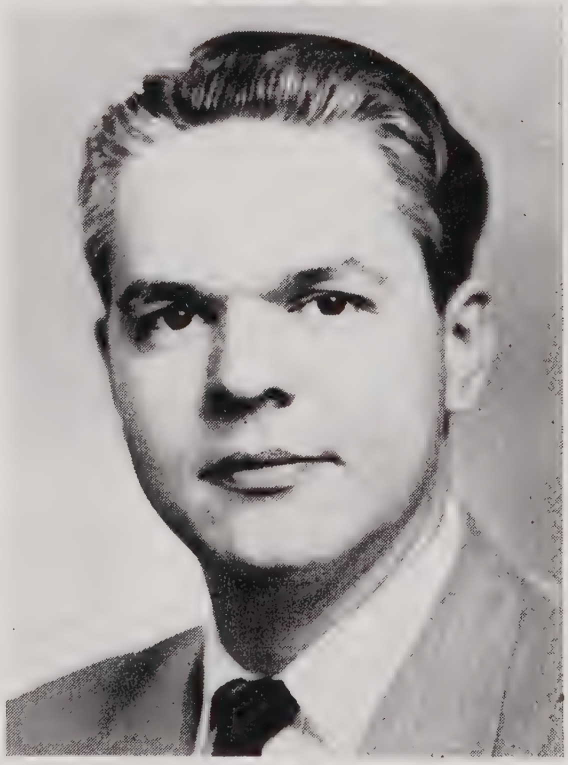


Dr. Edward R. Weidlein

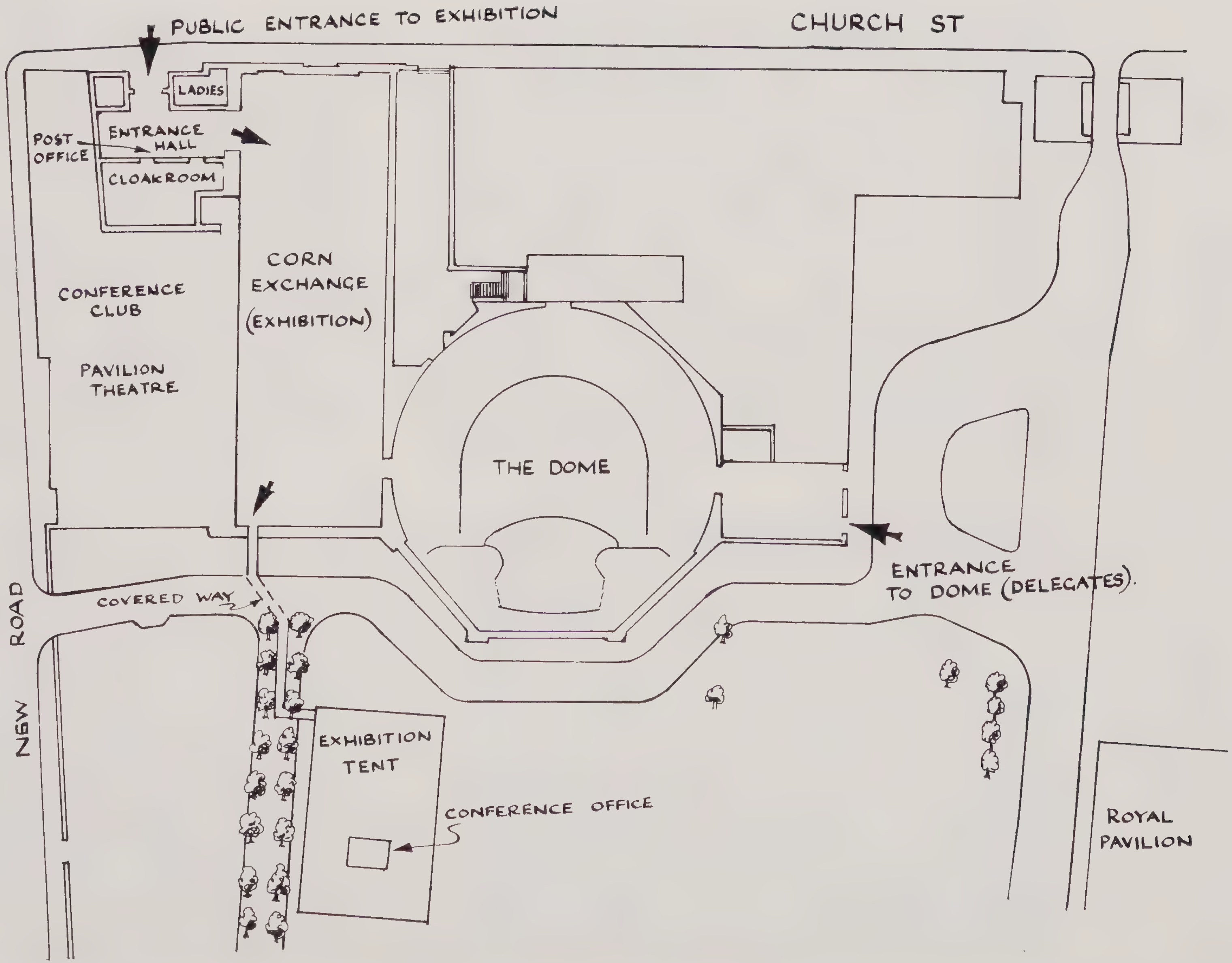


Dr. W. L. Faith

Arnold Arch



Dr. Richard A. Prindle



Plan
Showing
the Dome,
Corn Exchange,
etc.

Programme

# of the

Conference

All Conference Sessions and Film Shows in the Dome

Receptions in the Royal Pavilion

Tuesday Evening Informal Gathering at the Hotel Metropole

For details of Speakers, Authors, etc., see " Platform Who's Who ", page 29

Wednesday, 4th October

Morning

9.30 Exhibition open to Members and Delegates.

10.30 **Opening Session**

Chairman: The Rt. Hon. Lord Cohen of Birkenhead, President.

Welcome by the Worshipful the Mayor of Brighton, Councillor G. B. Baldwin, J.P.

Address and Opening of the Conference and Exhibition by John C. George, C.B.E., M.P., Parliamentary Secretary, Ministry of Power.

Presidential Address by Lord Cohen of Birkenhead.

12.30 approx. Lunch adjournment.

Wednesday, 4th October

Afternoon

Session II

Chairman: Stanley E. Cohen

2.30 Progress Report on the National Survey of Atmospheric Pollution.

Paper presented by Dr. S. R. Craxford, Dr. Marjorie Clifton and Mrs. M.-L. P. M. Weatherley.

Discussion.

3.30 Report on the Reception of the Society's Proposals for a Bill for the Certification of Furnace Operators.

Report to be introduced by Sydney N. Duguid.

Discussion.

4.15 Presentation of a Statement of the Executive Council on Smoke from Diesel Vehicles.

4.30 approx. Close of session.

5.30 Exhibition closes.

Evening

8.30 Reception at the Royal Pavilion by the Worshipful the Mayor of Brighton (by invitation).

8.00 Film Show in the Dome.

Thursday, 5th October

Morning

9.30 Exhibition opens.

10.00

Session III

Chairman: John Innes

The Industrial Operation of the Clean Air Act.

Presentation of Papers:

I. The Local Authority Viewpoint, by J. W. Batey.
II. Manufacturing Industry and the Clean Air Act, by W. J. Dickie.
III. Fuel Efficiency Aspects, by C. M. Opie.
IV. Boiler Plant Design and Equipment, by Arthur F. Webber.

Discussion.

12.30 Lunch adjournment.

Afternoon

2.30

Session IV

Chairman: Dr. J. L. Burn

Operation of the Clean Air Act: Industrial Questions and Answers Session.

Questions from members of the Conference (preferably sent in beforehand) on *industrial* problems will be answered by a Platform Panel including:

J. W. Batey, W. J. Dickie, H. A. Haines,

Dr. A. Parker and A. F. Webber.

4.20 Close of questions and answers session.

4.30 **Transatlantic Telephone Link-up.** Discussion between U.S. team in America and U.K. team on platform.

U.S. Team	*U.K. Team*
Dr. E. R. Weidlein, *Chairman*	Sir Hugh Beaver, *Chairman*
Arnold Arch	James Goodfellow
Dr. W. L. Faith	Dr. P. J. Lawther
Dr. R. A. Prindle	Douglas Lister
	Arnold Marsh

5.10 Close of Transatlantic Session.

5.30 Exhibition closes.

Evening

8.30 Reception at the Royal Pavilion by the Worshipful the Mayor of Brighton (by invitation).

8.00 Film Show in the Dome.

Friday, 6th October

Morning

9.30 Exhibition opens.

10.00

Session V

Chairman: James Goodfellow

Whole-House Heating Systems.

Paper by W. F. B. Shaw.

Discussion.

12.30 Lunch adjournment.

Friday, 6th October

Afternoon

2.30

Session VI

Chairman: John Innes

Operation of the Clean Air Act: Smoke Control Areas.

I. " Smoke Control Areas—Why such Slow Progress? " Paper by G. W. Herrick.

II. The Solid Smokeless Fuels Situation.

Paper from the Solid Smokeless Fuels Federation presented by David E. Baird, supported on the platform by J. O. Cooke, Dr. F. J. Eaton, J. Barratt, F. L. Waring and H. Giblin.

Dr. Eaton will also deal with any questions relating to Gas, and also on the platform will be J. I. Bernard for questions on Electricity and P. Draper for questions on Oil.

Discussion.

4.15 Any resolutions; votes of thanks.

4.30 approx. Close of session and of Conference.

5.00 Close of Exhibition.

——*Be well read on clean air !*

SOME N.S.C.A. PUBLICATIONS

Available at the Bookstall

CONFERENCES:

International, 1959 (Diamond Jubilee)	30s.
Harrogate, 1960	25s.

EVELYN:

John Evelyn's famous "Invective" on "The Smoake of London Dissipated" (1661) The Society's Tercentenary Edition

Cloth-bound	5s.
Paper-back	2s. 6d.

PUBLICITY:

N.S.C.A. Publicity Advisory Service: Catalogue of Exhibits, Posters, Leaflets, etc.	*Gratis*

LEAFLETS:

Single copies gratis

"They Didn't Know what to do"	£1 10s.	per 1,000
"Facts about Smoke"	£6 10s.	per 1,000
"Clean Air Begins at Home" (New)	£6	per 1,000

—*and of course, the CLEAN AIR YEAR BOOK* (2*s*. 6*d*.) *and SMOKELESS AIR* (2*s*.)

Be prepared for Smokeless Zone Regulations!

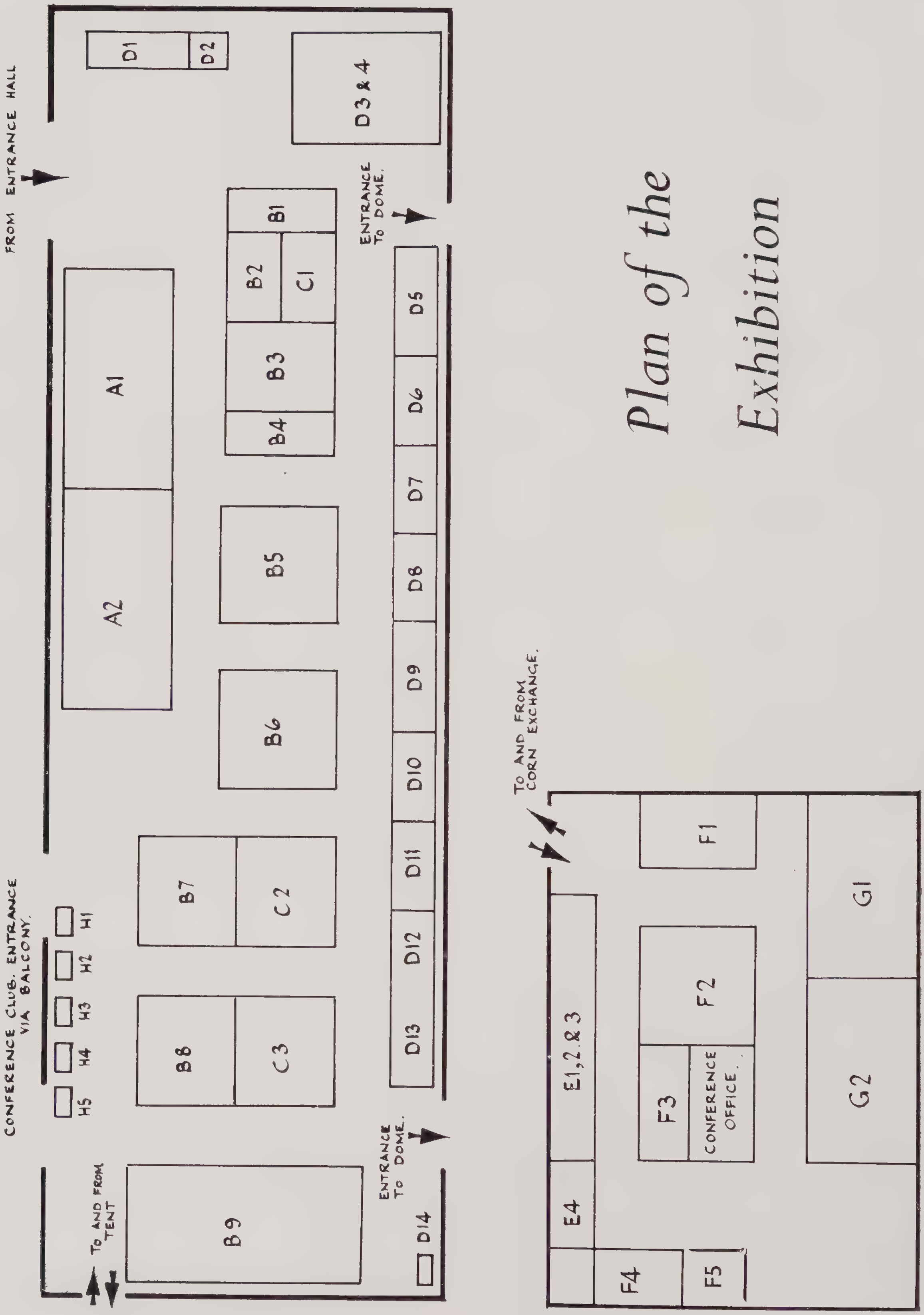
The illustration shows " Dustrol "
(Patent No. 723121) hoods installed in the
modern non-ferrous foundry of
BARR ST. CASTINGS LTD., BIRMINGHAM
This Plant is fitted with a fabric filter
collecting zinc oxide and dust particles
with no visible discharge to atmosphere
Why not bring your plant
up to the same high standard

Sole Manufacturers

NEWTON COLLINS
LIMITED

BARFORD ST. WORKS, BIRMINGHAM 5

SPECIALISTS IN DUST AND FUME REMOVAL
FOR OVER 40 YEARS



Plan of the Exhibition

THE EXHIBITION

In the Corn Exchange and adjoining Frame Tent. Open from 9.30 a.m. to 5.30 p.m. on Wednesday and Thursday, October 4th and 5th, and from 9.30 a.m. to 5.00 p.m. on Friday, October 6th.

LIST AND DESCRIPTION OF EXHIBITS

The information given in this list has been supplied by the Exhibitors and no responsibility for any of the statements or descriptions can be accepted by the National Society for Clean Air

Stand No.

H4 ADVERTISING HOLDINGS LIMITED, 86-88 Richmond Road, Kingston-on-Thames, Surrey.

Exhibited on the Advertising Holdings Limited stand, is an example of their Size L.4 " Movotron " apparatus containing a 23½ in. dia. animated disc of the Redheugh De Poray Vertical Coal-Fired Industrial Boiler.

This animation system which has been in widespread use on the Continent for some years, has only recently been introduced into this country, and despite its short life here has met with resounding success, especially in engineering and industrial fields.

The tremendous potential of " Movotron " is due to its ability to show, in minute technical detail, the various complex operations of boilers, precipitators, internal combustion engines, pumps, oil burning equipment, ventilation systems, chemical plant, condensers, descaling processes and innumerable mechanical movements.

The illusion of movement is achieved by coating an engraved metallic foil on to the surface of a hardboard disc, which is then placed in a cabinet containing a system producing the effect of revolving lights. These, shining on the foil, create a vivid and strong illusion of movement.

Any variety and combination of colours, speeds and movements may be shown with this simple but highly effective medium, and differential speeds, reciprocating motions, and the superimposition of one movement upon another present no obstacles.

The exhibit demonstrates the operation of the Redheugh De Poray Vertical Coal-Fired Industrial Boiler, which was specifically designed to prevent smoke-emission both to eliminate atmospheric pollution and wastage of fuel.

For the first time with Vertical Boilers, using natural draught, the Redheugh De Poray Boiler gives the exceptional advantage of high efficiencies with no smoke in a simple and inexpensive manner.

This is achieved by virtue of an auxiliary air supply, controlled by a screen plate set inside the firing door, and a Secondary Combustion Chamber, known as a Diffuser, which provides the necessary temperature and mixing of gases to maintain and complete combustion.

F1 **ASSOCIATED ELECTRICAL INDUSTRIES LIMITED, Electronic Apparatus Division, New Parks, Leicester.**

Demonstrated on the stand is the AEI Dust Measuring Equipment for Power Stations and Processes. This equipment has been designed to overcome the shortcoming of methods of recording the density of smoke discharged through a duct or chimney.

The AEI system responds to dust area, but overcomes the disadvantage of optical methods, whereby flue gas velocity affects the indication, by automatically taking into account the product of particle number, velocity and area. This is achieved by providing the continuously flowing sample of gas with a corona environment, where all solid particles become electrically charged. The charge is proportional to the particle surface area.

The charge on the particles collected thereby form a current potential proportional to particle number, area, and flow velocity.

This current, after amplification, is used to either indicate or record the level of pollution. A warning can be given should the pollution rate rise above some pre-determined level.

When installed in a duct of a chimney, the inlet of this sampling equipment is placed so that average velocity conditions are presented to it. The outlet, in the form of a conical diffuser to overcome the impedance of the equipment to the flow of the gas being sampled, is also placed in the main duct stream.

To prevent condensation of moisture in the sampling equipment, the temperature of working parts is kept above dew point.

Build-up of dust in the equipment is prevented by automatically purging with air for a few seconds once every 20 minutes.

The equipment, being highly sensitive, will respond to particle diameters ranging down to 0·01 microns, and can monitor flue gases leaving dust arresting plant of large boilers with burdens of about 0·04 grains per cubic foot rising to 2 grains per cubic foot during soot blowing. A Recorder chart is available showing 24 hours running on a continuous load station.

D5 **BERRY'S ELECTRIC LIMITED, Touchbutton House, Newman Street, London, W.1.**

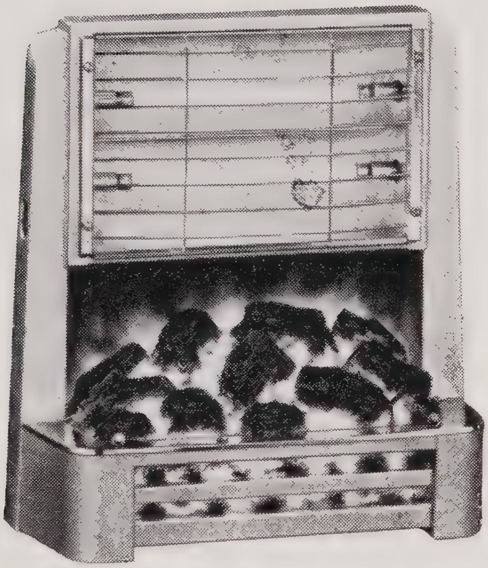
" Fires without smoke " is the theme of the Berry's exhibit. Magicoal fires, reproducing electrically the glow and movement of burning coal or logs, offer the perfect solution to the problem of abolishing smoke without losing the delights of an open fire.

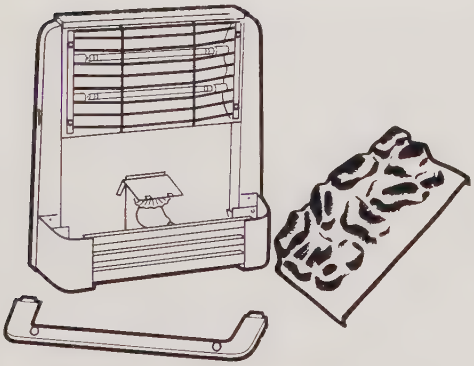
For PERFECT *smoke control . . .*

MAGICOAL

Regd. T.M.

ELECTRIC FIRES





ELECTRIC MAGICOAL is the perfect answer for Smoke Control Areas. It gives all the friendly warmth of firelight without so much as a puff of smoke or a speck of soot. Berry's most popular model, the Charmberry, is now available with special modifications which allow it to be installed as a fixed heater and so qualify for a Local Authority Grant. There is no extra charge for this, but the special Clean Air Act model should be specified when ordering.

Another model suitable for fixed installation is the Wellberry.

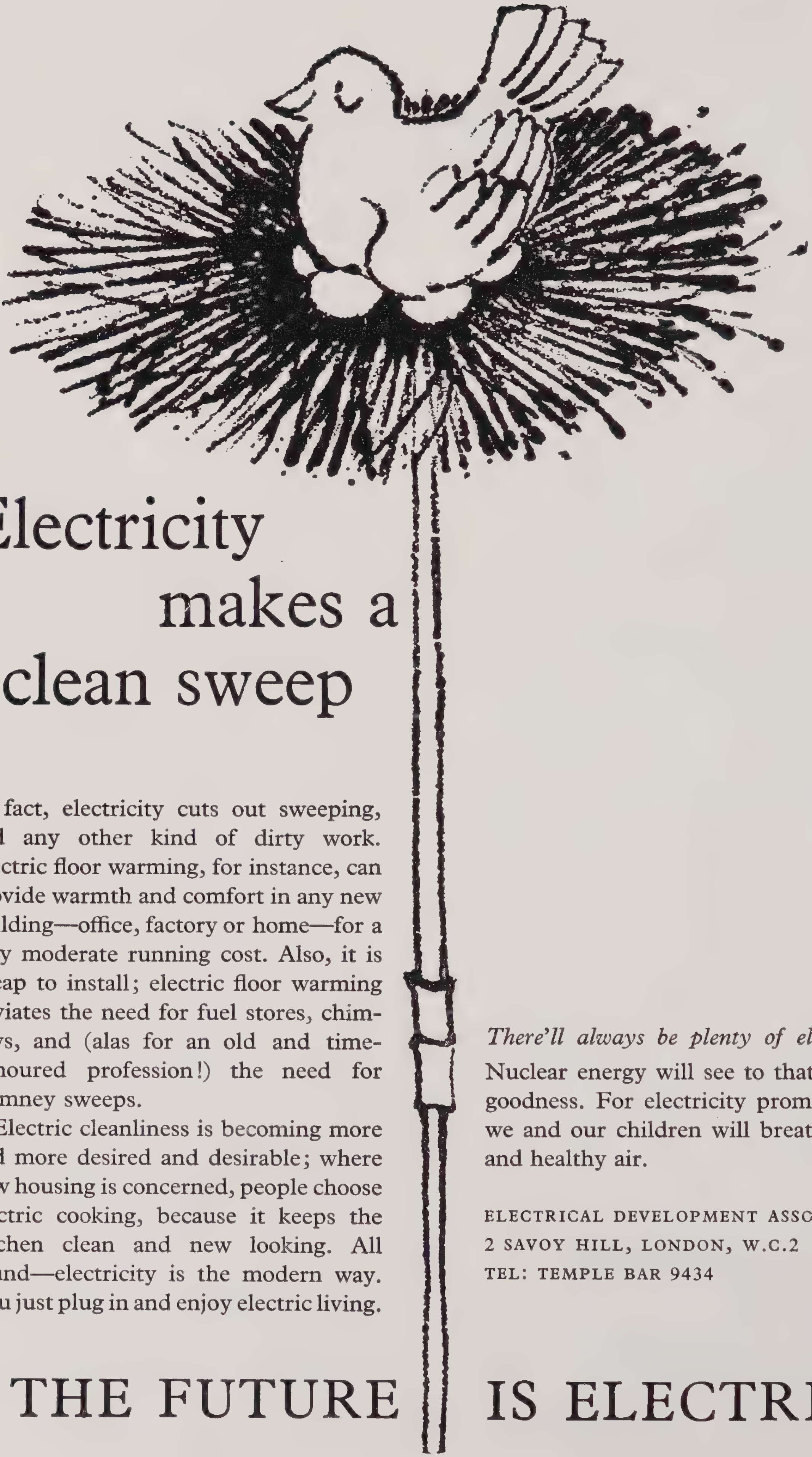
The fuel panels of these fires can be removed from the front; lamps and elements can be replaced while the fires remain fixed.

Berry's

BERRY'S ELECTRIC
MAGICOAL LIMITED

TOUCHBUTTON HOUSE · NEWMAN STREET · LONDON · W1

Information and Catalogues: *Second Way, Exhibition Grounds, Wembley Hill, Middlesex. (WEM 3201)*



Electricity makes a clean sweep

In fact, electricity cuts out sweeping, and any other kind of dirty work. Electric floor warming, for instance, can provide warmth and comfort in any new building—office, factory or home—for a very moderate running cost. Also, it is cheap to install; electric floor warming obviates the need for fuel stores, chimneys, and (alas for an old and time-honoured profession!) the need for chimney sweeps.

Electric cleanliness is becoming more and more desired and desirable; where new housing is concerned, people choose electric cooking, because it keeps the kitchen clean and new looking. All round—electricity is the modern way. You just plug in and enjoy electric living.

There'll always be plenty of electricity. Nuclear energy will see to that. Thank goodness. For electricity promises that we and our children will breathe clean and healthy air.

ELECTRICAL DEVELOPMENT ASSOCIATION
2 SAVOY HILL, LONDON, W.C.2
TEL: TEMPLE BAR 9434

THE FUTURE IS ELECTRIC

Stand No.

On Berry's stand will be two Magicoal fires which can be installed as fixed heaters to qualify for a grant. With them are illuminated fixed radiators, including the colour-changing Chameleon, and a magnificent period grate suitable for board-rooms or large reception rooms.

D14 BRITISH COKING INDUSTRY ASSOCIATION, 74 Grosvenor Street, London, W.1.

The British Coking Industry Association stand illustrates the uses of " Sunbrite " hard coke as both a domestic and an industrial fuel. Hard coke is an authorized smokeless fuel under the Clean Air Act, and ample supplies are available. Although produced mainly in the Midlands and North, it is distributed throughout the country through fuel merchants. In domestic applications, it is a fuel particularly suitable for closed appliances—stoves, domestic hot water and central heating boilers, and solid fuel cookers. On the stand the advantages of the modern appliances in these fields are shown—including a typical layout for domestic central heating.

The British Coking Industry Association believes that the more households can be persuaded to introduce modern heating equipment of this type the easier it will be to progress with Smoke Control Areas, for which the supply of specially reactive open fire fuels is limited.

In addition, large modern automatic coke boilers (up to 10m. B.T.U.s per hour), and adaptations of sectional boilers for automatic operation are available, providing simple, efficient and smokeless heating of larger buildings.

C3 BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION, 2 Savoy Hill, London, W.C.2.

With informative and interesting displays the E.D.A. exhibit shows how electric underfloor heating provides comfort with cleanliness and economy for bungalows, houses and flats, contributing with ever increasing effect, to the achievement of clearer skies over Britain. A special feature gives details of some of the numerous installations in daily use in municipally and privately owned properties in all parts of the country.

The advantages of the ring circuit system of wiring, which provides more economically for a really adequate number of socket outlets in the home, are also illustrated. Electric water heaters and cookers are but two examples of the part " Electric Living " is playing in the clean air movement and these and the recently developed electric firelighter for smokeless solid fuels are also shown.

A wide range of E.D.A. publications is available and a friendly staff look forward to meeting you and answering your questions about the exhibit or any other matter related to electricity supply or utilization.

B1 BRITISH IRON AND STEEL FEDERATION, Steel House, Tothill Street, Westminster, London, S.W.1.

Sources of air pollution in the iron and steel industry can be divided into two groups. Firstly, those in which simple combustion of " dirty " fuels leads to pollution of a type common to all users. Despite increased steel production, particulate pollution from these sources has in recent years been progressively and appreciably reduced as a result of increasing efficiency and the developing use of " clean " fuels: oil, gas and electricity.

The second group consists of specifically metallurgical sources, which still present technical difficulties in pollution control and are in consequence brought within the purview of the central Alkali Inspectorate. Each piece of equipment operating a process registered with the Inspectorate must operate with the " best practicable means " of reducing pollution.

" Metallurgical " pollution arises predominantly (in the form of very fine fume) from the new techniques of oxygen application to steelmaking and " dressing " of steel surfaces prior to rolling (scarfing). This is being dealt with by the development and installation of high-efficiency cleaning units. Three types of cleaner—electrical precipitators, bag filters and high-efficiency wet washers—have proved capable of meeting the high standards required, and a number are already in every day use; many more are on order for early delivery.

In some applications the major difficulties are encountered in the design of gas containment and cooling systems, or in dust disposal techniques, rather than in the de-dusting plant itself. However, the technical difficulties associated with most steelmaking processes have now been overcome.

Some idea of the size and complexity of cleaning plant can be gained from the fact that units recently ordered for one open hearth steelmaking department are expected to cost nearly £500,000.

The exhibit illustrates cleaning systems suitable for use with oxygen steelmaking processes and shows examples of what is being done.

D10 BRITISH RAILWAYS.

This stand will illustrate by photographs the contributions made by the Southern Region, British Railways, to clean air.

The further large-scale electrification of main line services undertaken by this Region is a major step towards the abatement of smoke. The introduction of oil-fired boilers at certain stations

-FIRE

without

SMOKE

with the

HOSKINSON

method of

RUBBISH DISPOSAL

ENTIRELY
SMOKELESS
INCINERATION

* Full details on request

BOSTON MARINE & GENERAL
ENGINEERING CO. LTD.,
HEATH TOWN WORKS, WOLVERHAMPTON.

and depots has also met with considerable success.

A representative will be in attendance for part of the time to answer technical questions as well as a train inquiry clerk.

B7 CENTRAL ELECTRICITY GENERATING BOARD

The Central Electricity Generating Board's exhibit on stand number B7 features the unceasing efforts made to avoid atmospheric pollution by power stations.

Various items of equipment used in these endeavours are on show and actual demonstrations of their functions are being made for the information of visitors.

Among the equipment on show is a flue dust monitor, portable and static SO_2 recorders, an absorptiometer and a dust gauge. The display includes photomicrographs of dust samples and colour slides on atmospheric pollution and its effects.

An item in the Board's exhibit which may be of special interest concerns the use of heat resisting balloons in power station chimneys for the purpose of tracking the direction and lift of chimney plumes.

There is a panel describing careers in the Electricity Supply Industry, together with a range of publications on various aspects of the Board's activities.

The enquiry staff on the stand will be pleased to answer visitors' queries.

B9 COALITE AND CHEMICAL PRODUCTS LIMITED, P.O. Box 21, Chesterfield, Derbyshire.

Live " Coalite " fires in open fire, open and closeable stove and cooker, can be seen on the stand. Large " Coalite " is the ideal smokeless fuel for every type of domestic grate, old or new, and openable or closeable stoves. " Coalite " Nuts, a smaller size, are equally suitable for cookers, openable or closeable stoves and hot water boilers.

" Coalite ", which is very reactive, will laze or blaze according to requirements. It may be allowed to laze throughout the night or on other occasions when not required but will draw up to a cheerful blaze immediately the air regulator is opened.

" Coalite " is readily ignited in the ordinary way with paper and sticks, fire lighter or gas poker and burns cheerfully with flame giving radiant heat, maximum comfort and economy.

" Coalite " is equally suitable as best house coal for the open fire and can be obtained from all leading coal merchants.

Prices vary throughout the country according to the geographical position in relation to the works and carriage charges that are involved. It is sometimes said that " Coalite " is expensive and whilst it may be true when this is considered initially in terms

'COALITE'
burns cleanly
in every grate

'COALITE' is the modern smokeless coal for open fires.

'COALITE' NUTS are the ideal solid smokeless fuel for modern boilers, cookers and stoves.

Both fuels are clean to handle, clean to burn, and authorised for use in smokeless zones.

Coalite and Chemical Products Ltd., Chesterfield, Derbyshire.
Telephone: Bolsover 2281/6

of shillings per hundredweight, the important point is that one buys by weight and consumes by volume. As " Coalite ", all of which burns away without risk of flying pieces, is of greater volume than coal, it is cheapest in the long run.

It is most important to note that " Coalite ", which is an approved smokeless coal, will burn satisfactorily in any type of grate or appliance without the expense of alteration.

A2 COAL UTILISATION COUNCIL, 3 Upper Belgrave Street, London, S.W.1, and at Aberdeen, Birmingham, Bristol, Cambridge, Cardiff, Edinburgh, Glasgow, Leeds, Manchester, Newcastle-upon-Tyne, Nottingham, Plymouth, Reading and Tunbridge Wells.

The Coal Utilisation Council is a non-commercial organization concerned with promoting the efficient domestic use of all solid fuels. In existing or proposed smoke control areas the Council's policy is aimed at the retention of the domestic market for solid fuel, either by the smokeless burning of coal where this is possible —for example by means of mechanical stokers in blocks of flats, offices, etc.—or otherwise by the domestic use of smokeless solid fuels.

The Memorandum on Smoke Control Areas, published by the Ministry of Housing and Local Government in connection with the Clean Air Act, quotes the C.U.C. as one of the organizations from which local authorities, contemplating the establishment of Smoke Control Areas, may obtain advice and assistance.

On display is a complete range of the various types of approved solid fuel appliances and of the authorized smokeless solid fuels, three different types of which are being shown burning daily. There is a demonstration showing how maximum efficiency can be obtained from an open fire by using it also to supply hot water and partial central heating. There is also a display on the small pipe central heating system which with its reduced installation costs, especially in existing houses, has brought central heating within the reach of more people than ever before.

The exhibit explains the ways in which the Council can be of service to local authorities that are setting up Smoke Control Areas, under the following headings:

Publications: The various publications issued by the Council which are available to local authorities are displayed. These include the List of Approved Domestic Solid Fuel Appliances (published jointly with the Solid Smokeless Fuels Federation) from which solid fuel burning appliances for replacement in Smoke Control Areas must be chosen.

Training Courses: The Ministry of Housing and Local Government Memorandum on Smoke Control Areas says that Local Authorities should ensure that new solid fuel appliances have been correctly installed in accordance with the methods recommended

These signs mean up-to-date advice and service to householders on home heating

COAL UTILISATION COUNCIL
CUC
APPROVED APPLIANCE
DISTRIBUTOR

A C.U.C. Approved Appliance Distributor has complied with certain stringent conditions of service. A number of his staff have attended a C.U.C. training course, and can advise on the C.U.C. approved appliances for heating homes with solid fuel—by far the cheapest method.

* *

COAL UTILISATION COUNCIL
CUC
APPROVED
APPLIANCE

A C.U.C. Approved Appliance, bearing this label, has been tested and is included in the List of Approved Domestic Solid Fuel Appliances published jointly by the Coal Utilisation Council and the Solid Smokeless Fuels Federation.

* *

COAL UTILISATION COUNCIL
CUC
APPROVED APPLIANCE
FIXER

A C.U.C. Approved Appliance Fixer is a building or plumbing firm that has satisfied the C.U.C. that it is competent to install approved solid fuel appliances. Each firm employs fixers with C.U.C. certificates, and undertakes that only certificated men will install appliances, and that such installations will conform to relevant British Standard Codes of Practice, C.U.C. recommendations, and local bye-laws.

When it's 'no smoke' by order —solid fuels are still the cheapest answer

Issued by the Coal Utilisation Council, 3 Upper Belgrave Street, London, S.W.1, and at: ABERDEEN · BIRMINGHAM · BRISTOL · CAMBRIDGE · CARDIFF
EDINBURGH · GLASGOW · LEEDS · MANCHESTER · NEWCASTLE · NOTTINGHAM
PLYMOUTH · READING · TUNBRIDGE WELLS

Stand No.

by the Coal Utilisation Council. To this end the Council have organized an Approved Appliance Fixers Scheme with the assurance that the firm displaying the Approved Fixers Sign will employ C.U.C. certificated men, and that the installation will conform to relevant British Standard Codes of Practice, C.U.C. recommendations and local byelaws.

Exhibitions and Publicity: The stand illustrates the various ways in which the local Joint Service Committees of the Council are helping local authorities in proposed Smoke Control Areas by means of exhibitions of various types, adapted to suit local conditions, advertising and leaflet distribution.

Technical Services: The technical services of the Council are available to any local authority in connection with the domestic use of solid fuel in Smoke Control Areas, and technical officers of the Council will be on duty on the stand.

B5 DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, Warren Spring Laboratory.

Air Pollution—A National Survey.

Air pollution measurements made by Local Authorities and other bodies were started primarily to meet local needs. In co-operation with D.S.I.R. this work has grown, over the years, to national scale.

More information is needed about the concentrations of smoke and sulphur dioxide in various types of town, and of localities within towns, where people live and work. A number of towns throughout the country have therefore been selected, by statistical methods, as representative. In these towns measurements are to be made at specified types of site. This should make it possible to obtain a picture of pollution which will serve as a yardstick against which conditions in every town in the country can be judged.

All measurements made with the daily volumetric instrument constitute the National Survey of Air Pollution. On the stand the pattern of the National Survey is indicated on an illuminated map.

Also on the stand are a simple illustration of air pollution by fine suspended particles and an instrument sampling the air in the Exhibition Hall.

D2 DISTRICT BANK LIMITED, 13 Spring Gardens, Manchester, 2.

D7 FLEMING RADIO (DEVELOPMENTS) LIMITED, Caxton Way, Stevenage, Herts.

In recent years pollution of the atmosphere has given rise to some concern and it is to assist those involved with this problem

IN THE CITY

" . . . . for personal service and friendliness — give me District Bank every time."

DISTRICT BANK

LIMITED

All delegates and visitors to the National Society for Clean Air Exhibition are invited to make full use of the banking facilites we are providing in the Corn Exchange, Brighton

that the Air Pollution Monitor Series II has been developed.

This instrument monitors continuously the pollution of the atmosphere and triggers an external alarm should a predetermined level of pollution be reached. This is achieved without reference to a comparator or the visual examination of a deposited stain on a filter paper, indeed the instrument will detect colourless particles with equal facility. Basically the standard instrument consists of a filter paper and its drive mechanism which reels the filter paper past an aperture through which air is drawn by a diaphragm vacuum pump. This creates a pressure differential across the filter paper which increases as particles in the air clog the paper. These pressure fluctuations caused by pollution of the air can be recorded externally on a strip recorder and also operate an external alarm signal by a pressure sensitive switch that can be preset to detect any desired level of pollution.

The sensitivity of the instrument is such that its application in the detection of air pollution is very wide, from early detection of leaking filters in a chimney exhaust to monitoring pollution levels in a clean atmosphere.

The development of the instrument has been taken a stage further to detect very low concentrations of chlorine in air. The basic Air Pollution Monitor is used in association with a device that produces a detectable dust on contact with chlorine. Although the Chlorine Detection Monitor is still in the last stages of development it is apparent that one part per million of chlorine in air will be detected and operate an alarm within twenty seconds. This principle can be applied to the detection of other gases and inquiries are invited in this connection. This instrument in either form is the subject of British Patent Application No. 31999.

H2 **FOSTER INSTRUMENT CO. LTD., Letchworth, Herts.**

The Foster Instrument Company are showing the smoke density equipment manufactured strictly in accordance with British Standards Specification B.S.28/11/1957. This equipment can be used as an indicating instrument with an indicating relay or an indicating alarm, or alternatively as a recorder or recording instrument with an alarm incorporated. The light transmitting source and the light receiving source are contained in an all-weather type metal housing and are fitted to binocular mounting plates which facilitate the checking and cleaning. Calibrated absorption screens can be supplied which permit an accurate check of the calibration in situ at intermediate points over the scale range of 0-100 per cent. obscuration. Also available as an optional extra is an everclean window attachment which is a special optical system and virtually eliminates window cleaning. This has been developed by the C.E.G.B. Research Laboratories at Leatherhead and is manufactured by us under licence.

Foster Instrument Company also manufacture a portable

SMOKELESS 'CALESTO'

GIVES INEXPENSIVE CENTRAL HEATING

The 'Calesto' Firegrate, built by Carron, offers the least expensive form of central heating you can get—plus the cheerful comfort of an open fire.

Thanks to its restricted throat and scientifically designed fireback, the 'Calesto' has a larger room heating capacity than any other open firegrate. It eliminates room draughts and is continuous burning on all solid smokeless fuels. With Heavy Duty Boiler Unit, the 'Calesto' can service up to 50 sq. ft. of radiator heating surface through a forced circulation small pipe system, and also provides a plentiful supply of domestic hot water through 25/30 gallon cylinder. If domestic hot water supply is not required it can service up to 100 sq. ft. of radiator heating surface (inclusive of piping). Further information gladly given.

CARRON

CARRON COMPANY
15 Upper Thames Street,
London E.C.4.
Telephone: CENtral 7581

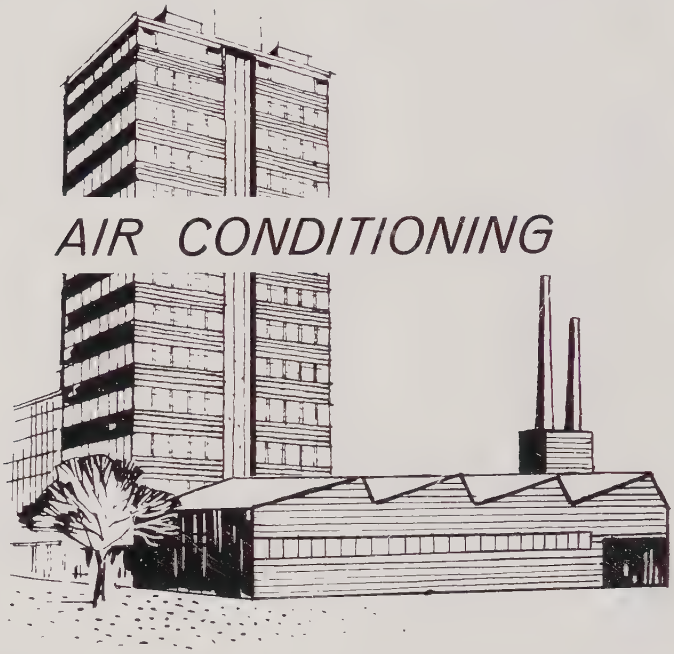
Chief Offices and Works:
Carron, Falkirk, Scotland

CLEAN AIR SYSTEMS

for British Industry and Commerce

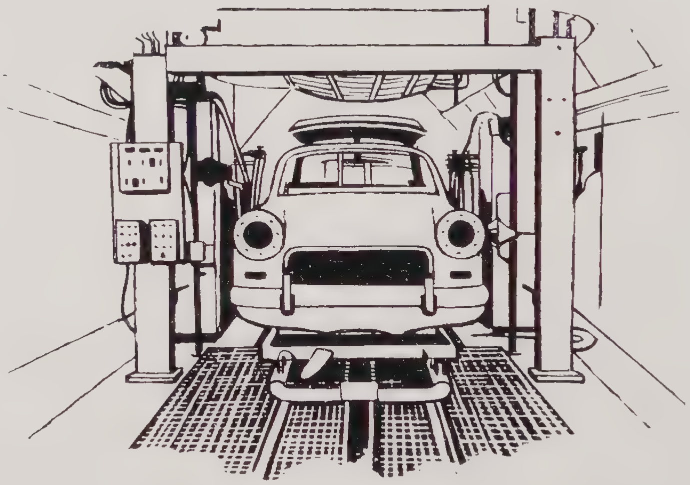
Carrier AIR CONDITIONING

Air Conditioning,
the solution to your
temperature humidity,
or airborne dirt
problems.



Carrier INDUSTRIAL FINISHING

Complete
finishing
installations
with all
ancillary
services
for quantity
production.



Carrier THERMAL ENGINEERS

A lifetime's experience in heating, drying and thermal control of processes

STAND 247, Heating, Ventilating & Air Conditioning Exhibition, Olympia

CARRIER ENGINEERING COMPANY LIMITED

24 Buckingham Gate, London, S.W.1

Export Subsidiary: DRYSYS EQUIPMENT LTD. Telephone Victoria 6858: Telex 23581

smoke density equipment designed as a really compact complete portable smoke density measuring equipment for use when setting automatically-controlled oil-burners in heating plants so that the elimination of smoke is achieved under all firing conditions.

Functions from nominal 200-250v. 50c. supplies.

Independent of mains voltage variation.

Instantaneous in response.

Indicator scale 0-100 per cent. obscuration.

Indicator, scale length 7 in., fitted with famous " Resilia " Moving Coil System.

Self checking at 0 per cent. and 100 per cent. obscuration.

C2 and E1 to 3 **THE GAS COUNCIL, 1 Grosvenor Place, London, S.W.1.**

The Gas Council's two stands (Gas No. C5 and Coke No. E1 to 3) are centres of up-to-date information on how the use of gas and coke in home and factory is contributing to the ideal of a smokefree Britain.

Inasfar as the domestic chimney is responsible for emptying nearly half of the smoke over this country, the use of gas in the home is of particular value in fulfilling the requirements of the Clean Air Act; at the same time it materially benefits family health and well-being and cuts cleaning bills for clothes, curtains, furnishings, windows and paintwork. Installation of modern gas-burning appliances is also easily accomplished: a gas cooker, sink heater, refrigerator, clothes washer or boiler, will fit compactly into the kitchen, while a gas radiant convector room heater will give instant warmth in a living room or bedroom, and eliminates all the dirt and drudgery arising from smoke pollution. Of special interest in the domestic field, are the new developments in central heating displayed on the stand which satisfy both the need for clean air and greater comfort. They include " small bore " central heating, which can be installed in existing houses with a minimum of structural alteration, unobstrusive pipe runs, and for a reasonable capital outlay; and gas warmed air heating systems to give either economical " selective " heating or full comfort in all rooms, passages and halls throughout a house or flat. In addition, a gas circulator, heating a water tank or cylinder, can be fitted to an air heating unit to provide constant hot water all the year round: only gas can give this combined smokefree heating and hot water service all round the clock and at such a relatively low cost.

Advantages of smokeless coke. Coke makes an excellent alternative smokeless fuel for winter space heating and water heating: a coke-fired boiler will give a combined central heating and hot water service in the most economical way possible; or coke will give all-day warmth and comfort with similar economy when it is burned either in an open fire or in a heating stove: both types of fire can be fitted with back boilers to give a full hot water supply at little extra cost in fuel consumption. Many open fires are supplied with a deepening plate which acts as a safety device when the room is unoccupied, and ensures that the fire can be banked up and will stay alight for a long period (or overnight). Open fires are also available with built-in gas burners which ignite the fire quickly.

Gas and coke, in brief, used either separately or in combination, provide the family with new comfort standards and meet perfectly all the requirements of the Clean Air Act for the domestic use of smokeless fuel.

Delegates are invited to visit the Gas Council's two stands, where expert advice on gas and coke and its contribution to Clean Air can be obtained.

D12 and 13 **E. GREEN & SON LIMITED, Economiser Works, Wakefield.**

The main features on the stand will be full scale exhibits of three main products of the Company, showing the interest and care which has been taken in the production of equipment to meet the requirements of the Clean Air Act.

The *Paraclone Dust Collector* is cut away to show the cleaning device which, allied to the unique form of cell construction, contributes largely to the high and sustained collecting efficiency obtained on the most difficult dusts. Among typical installations for this most advanced of Dust Collectors is its use in boiler plants, cement plants, iron and steel works and foundries. The construction of the Paraclone Dust Collector is such that it is readily and conveniently installed into the flue gas ducting and occupies the minimum of space.

The *S.K.D. Centrifugal Dust Collector* which is designed principally to meet the needs of the smaller shell type boiler installation, represents the ideal answer to the Collector space and cost problem. Maintaining a practically constant efficiency characteristic down to approximately 35 per cent. of full load by virtue of its built-in secondary circuit, it will operate even on oil smut at efficiencies approaching 75 per cent. On stoker-fired dust, efficiency is normally in the high nineties.

On the stand too, is shown the operation of a dust classifier by one of the Company's dust engineers, to illustrate the care with which each individual dust collecting problem is approached. Typical examples of classified dust will be available, and the machine will be operated for brief periods to demonstrate the manner in which the eight grades of dust are obtained.

Typifying the range of industrial fans is a *Series* 500 *Fan*, the smallest made by the Company. This fan has a forward curved multiblade impeller and is normally supplied for I.D. service on shell type boilers.

E. Green & Son Limited are not on this occasion showing their economisers which have been manufactured by the Company for over 100 years, but the staff will be available to give information on all the products manufactured by this Company if required.

D11 LESLIE HARTRIDGE LIMITED, 151 Great Portland Street, London, W.1.

The Hartridge B.P. Smokemeter is a reliable scientific instrument for accurately and quickly measuring the density of diesel exhaust smoke and thereby eliminating visual errors. The instrument is portable and gives an instantaneous direct reading of smoke density on a 0-100 scale. It is suitable for use by laboratories, factories, garages, service stations, police and health authorities and has been approved by the air pollution panel of the British Motor Industry Research Association after extensive tests on engine test beds and vehicles.

Principle: The principle is based on the comparison of the density of a column of smoke with a column of clean air. The smoke tube and clean air tube are optically and dimensionally identical and at one end of the tubes there is a 12 volt, 48 watt light source and the other end a photo-electric cell. These are so mounted on swinging arms that they can both be moved together from the smoke tube to the clean air tube, by the control lever. The photocell is connected to a micro-ammeter with smoke density scale reading 0-100 representing percentage light absorbed. A small 12 volt blower draws in air to the clean air tube which then passes across the surfaces of the light source and photocell. The air flow prevents sooting of these vital surfaces which, if contaminated, would give inaccurate readings of smoke density.

Method of Operation: A sampling pipe is introduced into the engine exhaust pipe by means of a special probe. The Smokemeter is then switched on and the control lever set to the air tube which is used as the basis for comparing the density of the smoke. The smoke density scale is then set to zero by means of a potentiometer indicating " no smoke ". The control lever is then moved to the smoke tube and an immediate reading of smoke density is recorded on the scale.

The latest machines incorporate a water trap, relief valve and smoke by-pass, all of which enhance the efficiency of the instrument and perfect the Smokemeter.

D8 L. G. HAWKINS & COMPANY LIMITED, 30-35 Drury Lane, Kingsway, London, W.C.2.

(1) L. G. Hawkins are exhibiting two newly developed fires this year. One is a new " Coal Effect " electric fire, which in addition to being manufactured in hammered silver and gold, is

this is a dust collector

Just leave it on your desk and see how quickly the dust collects! Even without this collector, the Holmes range of dust collection and control plant is still one of the most extensive in the world. Detailed technical brochures are available and can be had on request. Please ask for technical literature GCD/ 30

STAND No.
B 2

W. C. **HOLMES** & CO. LTD.

Gas Cleaning Division,
Turnbridge,
Huddersfield

Telephones:
Huddersfield 5280
London: Victoria 9971
Birmingham: Midland 6830

B.413-1

also being finished with a black or old ivory body, and reflector, guard and hob in 24 carat gold plate. The result is a very attractive electric fire, and thanks to the gold plate one which needs little or no cleaning—merely a dust with a soft duster.

(2) The " Florida "—a combined radiant/reflector fire of modern " slim-line " design has a triple wound element (protected by means of a " Thermoglas " panel) projecting radiant heat at floor level and convected heat from a height of approximately 12 in. from the ground. Switch control giving 2½ kW (high) and 1½ kW (low) make this a very attractive model.

(3) The other principal exhibit is the contemporary styled Hawkins Sunray Safeguard Oil Heater which is of course designed to the latest B.S.S. Standards. In addition to all the usual safeguards, this remarkable heater has two additional safety devices each operating the fuel control in an entirely different manner. If the heater is *lifted* (or knocked over) a simple mechanical device operates the fuel controller, and if, by any means, overheating occurs, a bi-metal cut out immediately cuts out the fuel supply.

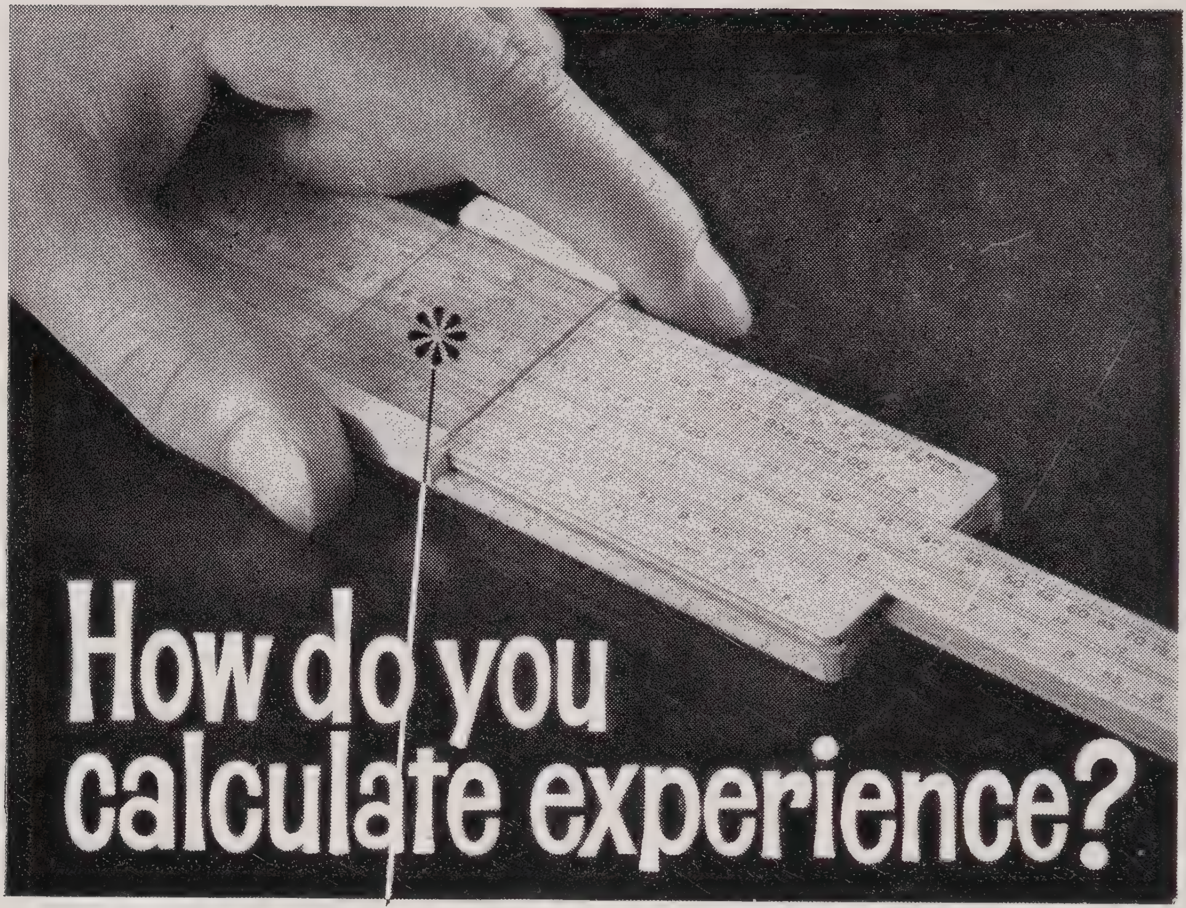
B2 **W. C. HOLMES & CO. LTD., Turnbridge, Huddersfield.**

Holmes-Elex Electrical Precipitator: Holmes-Elex Electrical Precipitators have been specifically designed for the removal of extremely small particles (in the sub-micron range) from all types of carrier gas. The particles, either liquid or solid are separated by passing the contaminated gas through a high voltage electrical discharge which imparts a negative charge to the particles and then deposits them on to collecting plates. The particles are subsequently removed from the collecting plates by various means depending on the application.

Industrion Electrical Air Filter: Removal of all particulate matter, ranging from approximately 60 microns to ·001 microns in size, from air and gas streams can be readily achieved by the use of an Industrion Electrical Air Filter. This filter can be used for all forms of air filtration, and it can be installed in any type of ventilation system to operate in conjunction with other air handling plant. Capacities of installations completed in the United Kingdom range from 250 c.f.m. to 200,000 c.f.m. Where necessary, larger capacities can be handled.

D6 **LION STAMPING COMPANY LIMITED, 35 Marshgate Lane, Stratford, N.15.**

In the field of domestic space heating nothing has been so spectacular as the increasing popularity of the radiant gravity-feed oil heater, and today over 12 million appliances of this type are used in homes throughout the country. Provided the purchaser has chosen wisely, they can expect to secure warmth at a fraction of the cost of other forms of heating, combined with a higher standard of comfort and convenience.



To the cement and lime industry	70
To the metallurgical industry	110
To the iron and steel industry	180
To the coal and gas industry	310
For power stations	330
To the chemical industry	330

BY NUMBERS?

Well over a thousand precipitator units is an impressive record. When related to the diversity of process, design and operation, it represents a massive experience.

BY TIME?

Lodge-Cottrell have specialised in precipitation for 48 years. Simon-Carves contribute 32 years of their own experience in plant of this kind. The total of 80 years of practical "know-how" is being supplemented continuously as new processes give rise to new problems and new solutions are found.

VISIT OUR STAND No. B8

1330 * precipitator units

LODGE-COTTRELL · SIMON-CARVES

MEMBER COMPANIES
SIMON ENGINEERING LTD

LODGE-COTTRELL LTD. George St, Parade, Birmingham 3, England,
and at London, Brussels, Calcutta, Johannesburg, Sydney, Toronto

In no small measure is the rapid development of this type of heater due to the Lion Stamping Company Limited whose specialized experience in both the domestic and industrial fields covers a period of nearly a quarter of a century. It was in 1946 that this company pioneered the first gravity-feed heater on the market and today millions of heaters bearing the familiar " Leo " trade-mark are in use throughout the world. Never content with the proven high efficiency of its free-standing models, the companies technicians have since 1956 devoted their energies to perfect a design to meet the requirements of most households—a *model that could be fixed safe* and *secure* in the *fireplace.* After much laboratory research and building special testing units to provide the most exacting chimney conditions, the Leo-Fi flued space heater was developed and production commenced early this year.

Clean Air Act: The Leo-Fi fully complies with the provision of the Act and is eligible for the 7/10th grant applicable to householders complying with a Smoke Control Order. You are cordially invited to inspect this unique model on our stand and obtain copies of the illustrated descriptive brochure containing full specification.

B8 LODGE-COTTRELL LIMITED, George Street Parade, Birmingham 3.

Lodge-Cottrell Limited, are pioneers of the electrical precipitator process of gas-cleaning and dust collection, developed from fundamental research work carried out by Sir Oliver Lodge at the turn of the century. The Company can take credit for some of the earliest, and certainly some of the latest, industrial precipitator applications.

At the C.E.G.B.'s new 2,000 MW Power Station, West Burton, the first in the country, and also at the new 1,400 MW Tilbury Power Station, all precipitators will be by Lodge-Cottrell Limited. Already long-established in the iron and steel industry, the Company has, in the last two or three years alone, secured major precipitator contracts for 21 blast furnaces, 29 sinter plants, 22 open-hearth furnaces and three LD converters, including a number of " firsts ".

Lodge-Cottrell's range of activities, apart from precipitators, include electrostatic coalescers, water clarification plant, plate valves for gas mains, etc., as well as pilot investigations to establish process conditions, and correctional work on gas distribution. A member company of Simon Engineering Limited, it enjoys vast technical and laboratory resources and is well placed for executing integrated contracts.

Exhibits include static and working models; display panels and typical electrodes; technical literature is available, and Lodge-Cottrell's specialist staff will readily discuss, without obligation. any problems of industrial gas-cleaning and dust collection.

Stand No.

B4 **METRO-FLEX GROUP OF COMPANIES, 47 Whitechapel High Street, London, E.1.**

Smutting with oil-fired boilers is often associated with low-load running. This is due to no fault of boiler or burner—in fact the more efficient a plant the more likely this trouble is to occur.

When, for example, a boiler designed for a winter heating load has to supply a trickle of summer hot water, temperatures throughout the flues fall because the heat input to the boiler is so low. Smutting is almost inevitable, usually accompanied by low-temperature corrosion, and certainly by poor efficiency.

METRO-FLEX demonstrate on Stand B4 a system specifically designed to meet these conditions. It can be installed on any boiler using any burners. Whenever the burners cut out a gas-tight seal is effected at the outlet, isolating the boiler completely from the chimney pull. No cold air passes to chill the flues. The boiler itself is used in another capacity—as a Thermal Storage Unit. All the stored heat is " sealed in " and none whatever is wasted up the stack.

Firing proceeds only at the burner's most efficient rate, and with a high heat input, but for much of the low-demand period the boiler is " sealed off ", consuming no fuel at all. Flue temperatures are maintained throughout.

With coal- or oil-fired boilers the METRO-FLEX system also provides a gas-tight seal during an overnight or week-end shut-down. Banking—a persistent cause of smoke emission—will be cut out completely, although a very quick start (with hot flues) is provided because of the stored heat. In addition the control of draught during a boiler's working time is precise.

Apart from smut and smoke prevention, substantial fuel savings are effected when the efficiency of a boiler normally falls to its lowest.

Further particulars of the unique METRO-FLEX Thermal Storage System will gladly be supplied by the makers.

B6 **MINISTRY OF HOUSING AND LOCAL GOVERNMENT, Whitehall, London, S.W.1.**

The progress of smoke control will be shown on the Ministry stand on a large illuminated centrepiece map of England and Wales and on separate regional maps. The maps will show the black areas, as provisionally defined, and the acreages subject to smoke control in them.

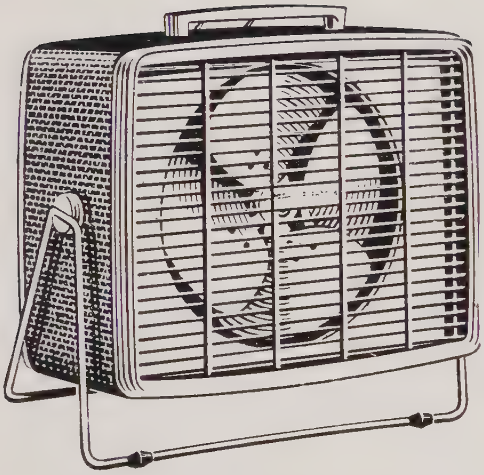
F2 **MORPHY-RICHARDS (CRAY) LIMITED, 50 Conduit Street, London, W.1.**

Morphy-Richards are exhibiting their complete range of domestic heating appliances, including their most recent additions;

MORPHY-RICHARDS

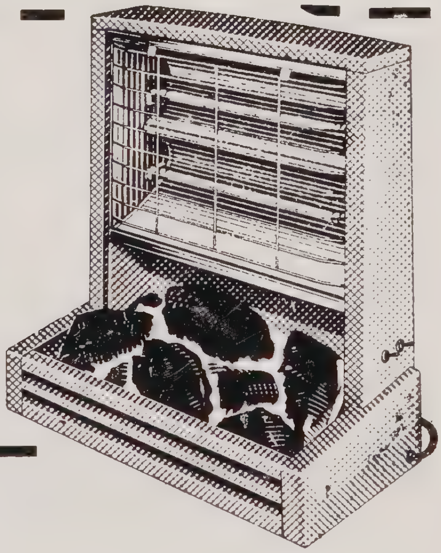
HOME HEATERS

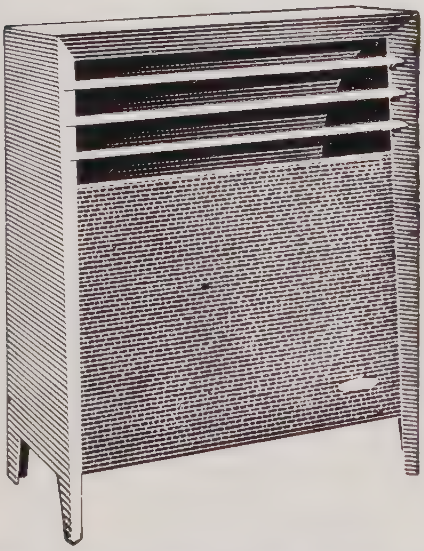
All Morphy Richards heaters are ideal for Smokeless Zones



Bermuda Fan Heater	£ 9 1 3
California Fan Heater	£12 11 9

Solway Coal Effect Fire £12 15 10





Sheerline Convector		£ 7 17 4
Derwent Convectors	From	£ 8 7 6
Small Bedroom Heater		£ 8 1 9
Conway Convectors	From	£ 6 7 11
Medway Radiant Convectors	From	£ 8 17 8
Derwent Radiant Convectors		£14 17 0
Avon Radiant Fire		£ 5 11 8
Cray Radiant Fires	From	£ 2 18 5
Infra Red Heater		£ 5 1 0
Free Standing Infra Red Fire		£ 4 18 0

namely the Solway coal-effect radiant fire, the free-standing infra-red heater and the Derwent radiant convector.

This superb range of home heating appliances make it simple to warm a home in just the way it is wanted. In the cleanest way too. Electric heaters need no attention, make no mess . . . leave no soot or ashes to clear away, and they comply fully with the new regulations governing smokeless zones.

The Morphy-Richards range fully solves all heating problems, from a small radiant fire for " spot " warmth, convector heaters for background warmth, fan heaters for speedy room heating, infra-red fires for chilly bathrooms, to the large radiant convectors. Morphy-Richards electric heaters are masterpieces of design and efficiency and give excellent value for money.

All Morphy-Richards appliances combine first-class materials, imaginative design, brilliant engineering and up to the minute techniques of mass-production.

To ensure very high standards of reliability and safety, close attention is paid to British and other national standards, where they are applicable. Many appliances have also been selected for exhibition at the Design Centre as examples of first-class design.

H5 **MUNICIPAL ENGINEERING PUBLICATIONS LTD., and THE MUNICIPAL JOURNAL LTD., 3/4 Clements Inn, London, W.C.2.**

Displayed on this stand are *Municipal Engineering*, *The Municipal Journal*, *The Municipal Year Book* and sundry books and publications produced by other companies within the Group.

Municipal Engineering caters specifically for all the technical officers of local government whose work is directed towards improving health and welfare of the community.

In particular it is the weekly journal most widely read by Public Health Inspectors and engineers, officers who, under the Clean Air Act, are responsible for its administration. Its coverage of such matters as the control of air pollution, sanitation, food hygiene, meat inspection and slum clearance has made it essential reading for these officers.

The Municipal Journal each week highlights news and views on all aspects of local government affairs through co-operation with government departments, local authority associations and societies and individual councils. It keeps its readers abreast of current thought and development. Administration, finance, law, building and planning, public health, refuse disposal, sewerage, sewage treatment and control of air pollution—these and all other aspects of local government work are continually kept under review.

Recognized as the encyclopaedia of local government and as essential work of reference, *The Municipal Year Book* contains full

MAXIMUM SAFETY! LEO-FI

THE ONLY OIL HEATER DESIGNED TO BE FIXED IN THE FIREPLACE

SEE THE LEO-FI

The World's most advanced **OIL HEATER on STAND D6**

CLEAN AIR ACT

The only Oil Heater complying with the provisions of the Clean Air Act and ELIGIBLE for the 7/10ths GRANT

Heats the largest of rooms for LESS than $1\frac{1}{2}$d. per hour

----

Maximum heat output equals $2\frac{1}{2}$ K.Ws.

NO SMELL
Thermostatic vent takes off fumes up the chimney flue

Patented AIR COOLED Fuel Tank

£17/19/7 *including Purchase Tax*

NO SMOKELESS FUEL PROBLEMS

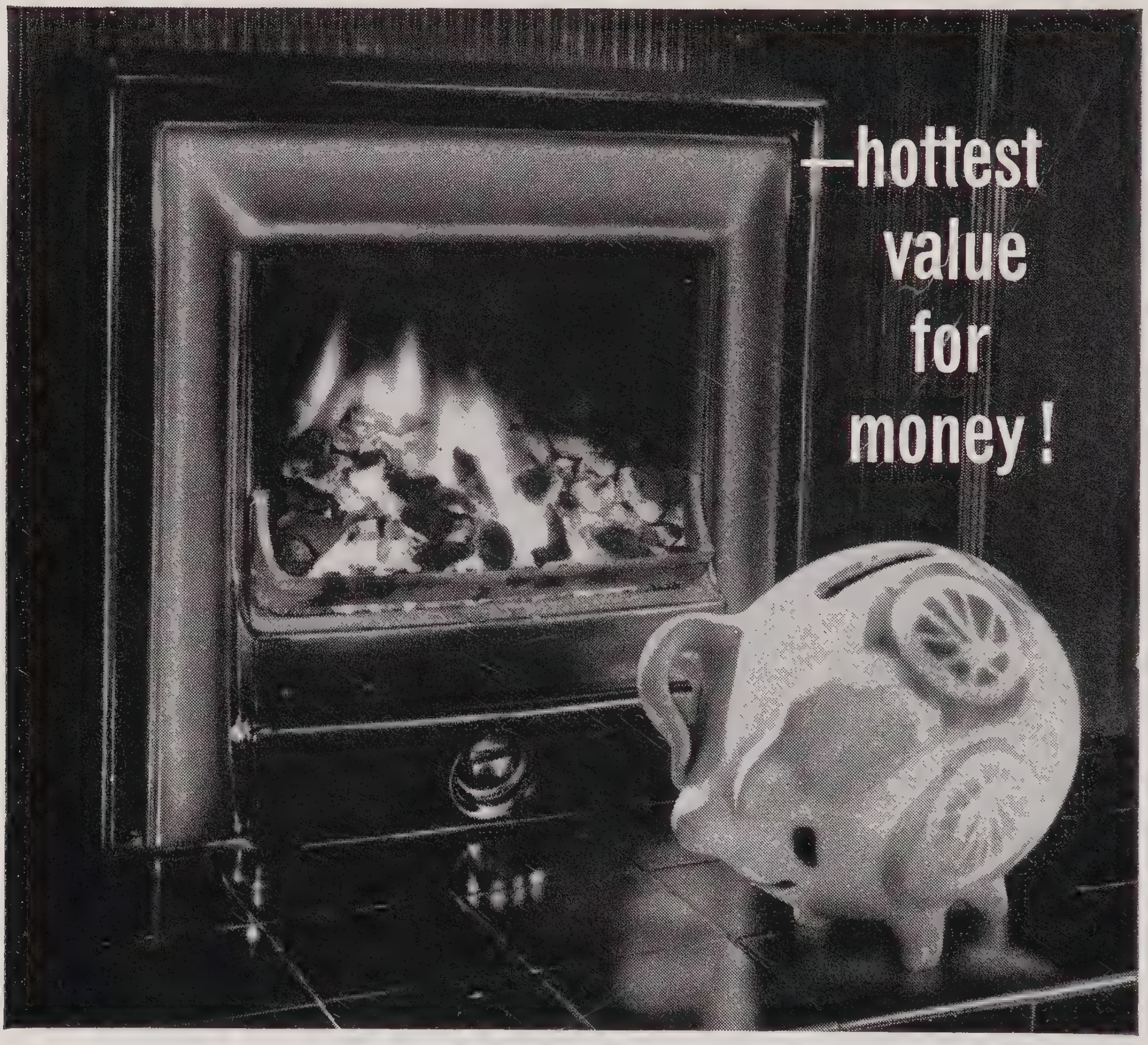
Supplies of paraffin plentiful and available Day or Night —at **LOW COST**

Write for descriptive illustrated brochure with full specifications to :

LION STAMPING CO. LTD.
MARSHGATE LANE
STRATFORD · LONDON E.15

REXCO

gives you more radiant heat



It's the radiant heat of a fire that counts—the heat actually thrown out to warm you. Rexco gives you more radiant heat than any other fuel, weight for weight. That's why it is the hottest value for money.

What's more, Rexco is clean coal; it lasts longer; and it does not dirty your curtains and furnishings.

Always ask your coal merchant for Rexco Smokeless Coal; and Rexco Nuts for your closed stove or boiler.

REXCO SMOKELESS COAL

NATIONAL CARBONISING COMPANY LTD. MANSFIELD, NOTTS

statistical data of all local authorities. It includes names, addresses and telephone numbers of 40,000 officers of local government and of associations, institutions and societies. In all some 2,000 pages.

F5 **MUSGRAVE & CO. LTD., St. Ann's Works, Belfast, 5.**

The Musgrave S.F. Dry-Type Electro Filter is a horizontal flow plate-type Electrostatic Precipitator. It is used to remove from gas or air the fume and smoke associated with the combustion of pulverized coal, oxygen steelmaking and cement manufacture, to name but a few processes. The dust is collected in a dry condition.

The Musgrave S.F. Wet-Type Electro Filter is a horizontal flow plate-type Electrostatic Precipator employing water flushing for electrode cleaning. It is used mainly in the steel industry for the cleaning of blast furnace gas and the elimination of iron oxide fume in oxygen steelmaking. The dust is collected in the flushing water from which it must be removed by water treatment plant.

The Musgrave Aerodynamic Collector ' K ' type is a high efficiency mechanical collector for low and medium dust concentrations. It is used for a wide variety of industrial applications where the dust is medium-fine. It is pre-eminently for stoker-fired shell type boilers and has been successfully applied to oil-fired boilers for the elimination of smuts.

The Musgrave Duodyne Collector is a cyclone-type of very high efficiency, capable of dealing with heavy concentrations. It is used extensively for industrial dust collecting applications giving good efficiency on very fine particles.

The Musgrave F.D. type is a wet mechanical collector providing practically total dust elimination with medium concentrations on a wide variety of dusts. It is a centrifugal type in which a rotor creates a continuous fine spray path through which the dust must pass. The dust may be removed from the water by settlement processes or other treatment plants.

The Musgrave Automatic Bag Filter is a multi-compartment type employing reverse air flow for bag cleaning. This may be supplemented where necessary by automatic shaking devices. A wide variety of filter fabrics is available to suit differing gas and dust conditions and high temperature applications.

Musgrave also exhibit a selection of their fan designs including the Musgrave NEU High Pressure, High Efficiency Blower.

D3 **NATIONAL CARBONISING COMPANY LIMITED, Mansfield, Nottinghamshire.**

The makers of Rexco Smokeless Coal have as the main feature of their stand a typical British fireside scene. It shows a lounge with an open fire blazing merrily in the hearth.

The preservation of this traditional scene in homes throughout the country is being made possible—despite the regulations of the Clean Air Act—by the existence of Rexco " Approved " solid fuels.

This modern form of heating in a traditional setting becomes increasingly popular every year and the National Carbonising Company is constantly stepping up its production.

Rexco is made from the finest quality large coals and when burned produces bright flames and a strong radiant heat without smoke.

It is easily ignited with paper and sticks and can be used successfully in any type of grate, old or new, thus avoiding the need to fit special grates and provide gas ignition.

At this exhibition, Rexco " Large " fuel is burned in a Redfyre Continuous Burning Fire with a back boiler unit giving radiant heat in the lounge, (a room of 1,500 cu. ft.), and at the same time providing domestic hot water for the bathroom and all supporting radiators with a total heating area of 70 sq. ft.

Of the grades available and on display at the Exhibition, Rexco " Large " is recommended for open type grates and Rexco " Nuts " is best suited for all types of domestic hot water boilers, stoves and cookers.

Also displayed are a number of Redfyre open fire back boiler units which are suitable for domestic hot water and part central heating. These have chrome steel bottom grates for long life and are Ministry approved.

A1 NATIONAL COAL BOARD, Hobart House, Grosvenor Place, London, S.W.1.

The National Coal Board stand shows the Board's contribution to the drive for clean air. It features " Sunbrite " as the ideal smokeless fuel for use in boilers and stoves. The display deals with the manufacture, availability, and correct use of " Sunbrite " for maximum efficiency and economy. Coke burning appliances suitable for commercial central heating in smoke control areas are on show together with a display on the Board's Housewarming Plan for advancing low interest loans for the purchase and installation of approved heating appliances.

A feature on the Board's technical services is included and the Board's clean air film " Arthur Clears the Air " will be shown in the cinema during the exhibition.

F3 NATIONAL SOCIETY FOR CLEAN AIR, Field House, Breams Buildings, London, E.C.4.

The Publicity Advisory Service has now been operating for over six months, and has already been able to help many of the Society's Local Authority members with their publicity problems. The Society's stand is devoted to illustrating the Publicity Advisory Services three main objectives:

(1) To give advice on display material—its arrangement for exhibitions, stands, etc.

How the National Coal Board contributes to clean air

The National Coal Board produces not only natural smokeless fuels (anthracite and Welsh dry steam coal). Its fuel technologists are continuously at work, developing new smokeless fuels that will be even hotter, cleaner and more economical than any solid fuel now available. National Coal Board smokeless fuels not only cut down dirt in the air, in the chimney and in the home. When burnt in modern appliances, they save dramatically on your fuel bills by giving far more warmth for your money.

VISIT STAND A1 AND SEE NCB SMOKELESS FUELS DEMONSTRATED

National Coal Board

Stand No.

(2) To give guidance on the general organization of exhibitions.

(3) To advise on and supply general information on other publicity activities, such as meetings, Local Press features and correspondence, education work in schools, women's organizations, etc.

Copies of the Society's publications will be available from the adjoining Conference Office, together with H.M. Government publications.

E4 **THE PFIZER GROUP OF COMPANIES, Sandwich, Kent.**

The Pfizer Group of Companies consider it a privilege to take part in this exhibition. Our stand is an endeavour to describe graphically the damage which can be caused to organic and inorganic matter by polluted air.

The piece of masonry demonstrates the corrosive atmosphere mankind lives in. If this happens to hard stone what happens to the delicate membranes and tissue of children and men?

The picture of an Elizabethan warship reminds us that from the thirteenth century onwards, while production of great vessels of war and other means of destruction occupied men's minds, people with vision struggled against ignorance to bring about an enlightened approach to the evil of air pollution.

The photograph of the rocket launching site indicates that man has advanced in science and technology almost beyond the understanding of ordinary men and women, yet to a great extent the problem of air pollution is still with us.

The picture of the mediaeval street scene shows conditions which prompted Queen Elizabeth I to complain of the fetid odours often caused by the " smoke of sea-coles " and the photograph of a modern industrial town shows a striking example of the picture of what can happen today. Undoubtedly the problem is still with us.

The presence of pollution is demonstrated by two filters, one before use, and one after use, in the Festival Hall, South Bank, London.

The picture of the Pfizer factory is where research is carried out to combat some of the ravages caused to man by unclean air.

Pfizer is also proud to remind everyone of men like John Evelyn whose tri-centenary is celebrated this year and also Edwin Chadwick and others who brought about public and official reaction to the problem of disease caused by foul air.

D1 **THOMAS POTTERTON LIMITED, Cavendish Works, Buckhold Road, Wandsworth, London, S.W.18.**

Thomas Potterton Limited have been manufacturing boilers for more than 70 years and can well claim to be among the foremost boiler manufacturers of today.

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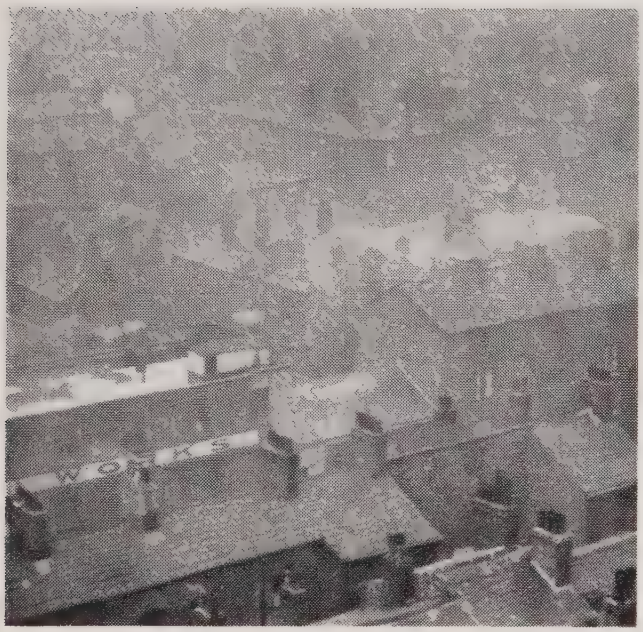
PROBLEM

WITH US TODAY



The Pfizer Group manufactures chemicals, pharmaceuticals, vaccines, agricultural and veterinary products. It also carries out research for new and better drugs for men and animals. The prevention of disease is very much our concern, for we know that prevention is better than cure. We are pleased, therefore, to make our contribution to the success of this important exhibition because air pollution is responsible for so many diseases, particularly those which affect the organs of respiration.

We hope our exhibit will interest you. It shows that yesterday's problem is indeed with us today and unless we take heed of this it will be with us tomorrow.

If you would like to know about the Pfizer Group, and the work which we do for the health of the Nation, please write to:

Pfizer

Director of Public Relations
The Pfizer Group
Sandwich, Kent.

Stand No.

"Potterton" gas and oil-fired boilers are available in a wide range of sizes for central heating and hot water, and are specifically designed to meet the requirements of domestic, commercial and industrial premises.

To ensure dependable service, all "Potterton" boilers are made of cast-iron. They are fully automatic and give a very high working efficiency. They are economical in operation, make no dust, smoke or ash and are suitable for installation in areas covered by the Clean Air Act.

The boilers are of sectional construction and the smaller sizes are delivered completely assembled for easier installation. The smaller boilers have a smooth coating of vitreous enamel on the flueway which simplifies maintenance, and gives additional protection against corrosion.

H1 **PYRAMID PRESS LIMITED, Publicity House, 41 Streatham Hill, S.W.2.**

Pyramid Press Limited are specialists in the production of handbooks which are published free of all cost to the local authorities concerned. These books are designed to inform householders of the general provisions of the Clean Air Act and particularly their obligations as far as their own control area or smokeless zone is concerned.

These books have a local application and are usually distributed in connection with a local authority scheme.

Your enquiries and suggestions regarding the application of our publishing facilities are cordially invited at Stand No. H1.

H3 **SANIGUARD APPLIANCES LIMITED, 62 London Wall, London, E.C.2.**

G2 **SHELL-MEX AND B.P. LTD., Shell-Mex House, Strand, London, W.C.2.**

Although petroleum fuels are normally burned without visible smoke, and therefore oil burning installations do not even approach the level of smoke emission that is permitted by the Clean Air Act, it is still desirable that all the flue gases from any combustion system are properly dispersed into the upper atmosphere.

The Shell-Mex and B.P. exhibit shows that the products of combustion from burning normal fuel oil can be controlled to below Ringelman I; it also indicates how local topographical conditions must be taken into account in chimney design in order to avoid entrainment of flue gases in down currents of air.

Chimney treatments to obtain good dispersal of gases and to avoid condensation, corrosion, and the possible production of smuts are shown.

Shell-Mex and B.P. Ltd. have always taken a close interest in the efficient use of the products which they market. Their experience of oil burning is unrivalled and they are always pleased to share their knowledge with fuel users and Local Authorities.

Literature on the efficient use of oil fuels is available, and may be ordered at the stand, where technical staff will be pleased to discuss any aspects of the use of petroleum fuels in continuous combustion processes.

G3 SMITH BELL & CO. (LONDON) LTD., Marlon House, Mark Lane, London, E.C.3.

G1 SOLID SMOKELESS FUELS FEDERATION, 74 Grosvenor Street, London, W.1.

The main theme of the stand is to outline the main points brought out in the paper presented at the Conference by the Solid Smokeless Fuels Federation.

The whole range of fuels available will be displayed in groups to suit the different types of appliances and for easier recognition and identification purposes.

Two appliances will be working to demonstrate the ease with which these fuels can be burned and to illustrate their efficiency.

Inquiries will be welcomed on the stand for the use of the Federation's exhibition equipment, mobile exhibitions and literature.

D9 SOUTH-EASTERN ELECTRICITY BOARD (SEEBOARD), 10 Queens Gardens, Hove.

The electrical way to clean air shown on Seeboard's stand includes alternative space heating methods, the production of hot water and the lighting of solid smokeless fuels.

Space heating is illustrated by block storage heaters which are automatically switched on during off-peak times when electricity is cheap and give off their stored heat during the daytime. These are particularly suitable for warming offices, shops and factories. Floor warming for new homes and other buildings is illustrated and this method also enables advantage to be taken of cheap off-peak rates.

How to provide hot water without a flue is demonstrated by a neat electric waterheater which can be tucked away under the basin or in an adjacent cupboard.

These appliances meet admirably the requirements of the Clean Air Act and Hygiene Acts.

A means of kindling smokeless fuel by electric heat came on to the market last year. In this firelighter the hot air blast is driven over the fuel which is ignited in a few minutes. The device may also be used to draw up a fire rapidly. The electric firelighter qualifies for grant under the Clean Air Act.

B3 J. STONE & COMPANY (DEPTFORD) LIMITED, Arklow Road, London, S.E.14.

Stone-Vapor boilers are oil-fired, forced circulation water tube boilers that provide, in single or multiple installations, an automatically modulating output that closely follows the steam demand. Fully self-contained and easy to install, they are about one-quarter the weight and one-fifth the size of conventional boilers of the same rating; accordingly, they can be positioned with advantage wherever required and at any level—even on the roof.

There are no problems of air contamination with these boilers. Robust Servo modulating controls, regulating within close limits the fuel/air ratio, not only maintain economy of operation on a year-to-year basis but also preclude the formation of smoke and smuts at all times. A typical exhaust stack analysis on a percentage of volume basis is as follows:

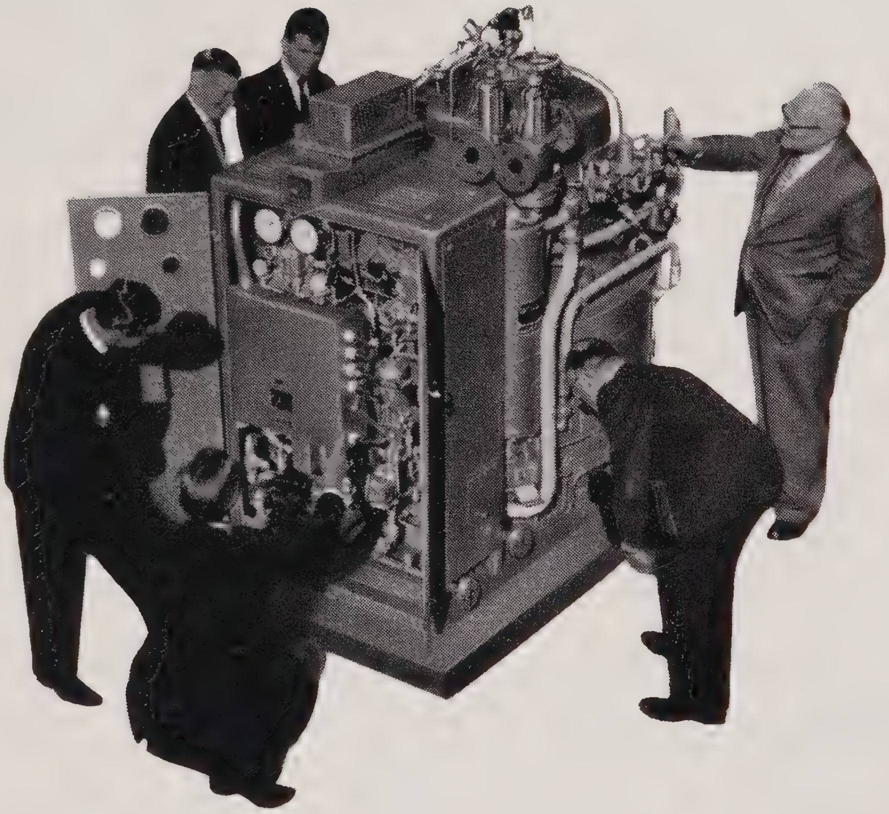
CO_2	10-11 per cent.
O_2	6 per cent.
CO	0 per cent.
SO_2	·000005 per cent.
N_2-H_2O	Remainder
Smoke	Shell Scale O (*i.e.* approx. 2 grains per 1,000 cu. ft., equivalent to approx. 125 grains per hour.)

Steam is raised within two minutes of a cold start, and thereafter produced only when required. Steam dryness is in excess of 99 per cent. Owing to the automatically modulating output, there is no wasted fuel or water. Other important advantages include easy, speedy installation; simple operation and maintenance; the ability to handle peak and minimum loads at the same high efficiency; constant supervision is not necessary.

Industry has found important heating and processing applications for Stone-Vapor boilers, in which their small size, light weight, compact design, robust construction and operating economy have proved of immense value. At the present time, over 20,000 are in service throughout the world.

C1 THERMALAY LIMITED, Shelf Mills, Shelf, near Halifax, Yorkshire.

Carpet Heating for Everyone: Some years ago, a new company was formed, Thermalay Limited, Shelf, Halifax, to develop a new approach to comfort heating in the home.



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A normal sized room can be heated for 1d. per hour, maintaining an adequate comfort level in all but the very coldest days.

Thermalays are available at Electricity Showrooms and leading electrical dealers.

F4 **THE WOMEN'S ADVISORY COUNCIL ON SOLID FUEL, 18 South Molton Street, London, W.1.**

The Women's Advisory Council on Solid Fuel hopes to interest conference delegates in the service which its staff can give in proposed smoke control areas, to which reference was made in Circular 28/60 published by the Ministry of Housing and Local Government.

Women's meetings can be organized at which the talk " Bright Future ", illustrated with coloured slides about the implementation of the Clean Air Act, can be given.

Training courses can be held for groups of women concerned with house visiting—such as W.V.S., health visitors, district nurses and home helps.

The Council is particularly interested in helping the elderly to understand the use of new appliances and unfamiliar solid fuels and can arrange talks to members of Darby and Joan clubs. Group demonstrations can be given in houses or flats.

Delegates are invited to ask at the stand for details of these services and about free supplies of the leaflet " The Clean Air Act and the Housewife ".

Miss J. H. Prentice and Miss O. Robertson will be in attendance.

S·S·F·F·
SERVICE

to Local Authorities promoting CLEAN AIR

S.S.F.F. Exhibition Stand displaying approved solid smokeless fuel appliances under fire and the full range of authorised fuels

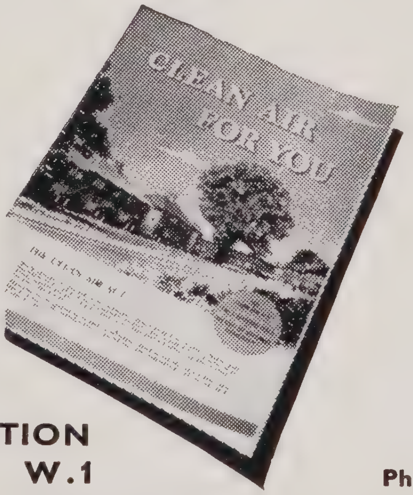
Local Authorities promoting " Clean Air " campaigns or establishing Smoke Control Areas are invited to enlist the advice and assistance of the Solid Smokeless Fuels Federation. The Federation will organise or participate in Clean Air Campaigns or individual exhibitions under the auspices of the Local Authority. Services of this kind have been provided for Local Authorities up and down the country. The S.S.F.F. exhibition stand and mobile exhibition units are supplied free and have been prominent features of such campaigns.

S.S.F.F. Mobile exhibition unit displaying approved solid smokeless fuel appliances under fire and the full range of authorised fuels

LITERATURE AVAILABLE

A RANGE OF LITERATURE IS AVAILABLE FREE TO LOCAL AUTHORITIES

This deals with the Clean Air Act, explaining its provisions and how it must be implemented. There are publications describing modern approved appliances to comply with the Clean Air Act and how to get the best out of them and on the authorised solid smokeless fuels and their application. For specimens or for further information apply to:



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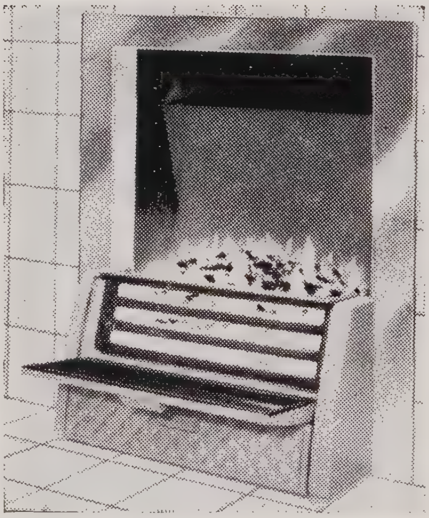

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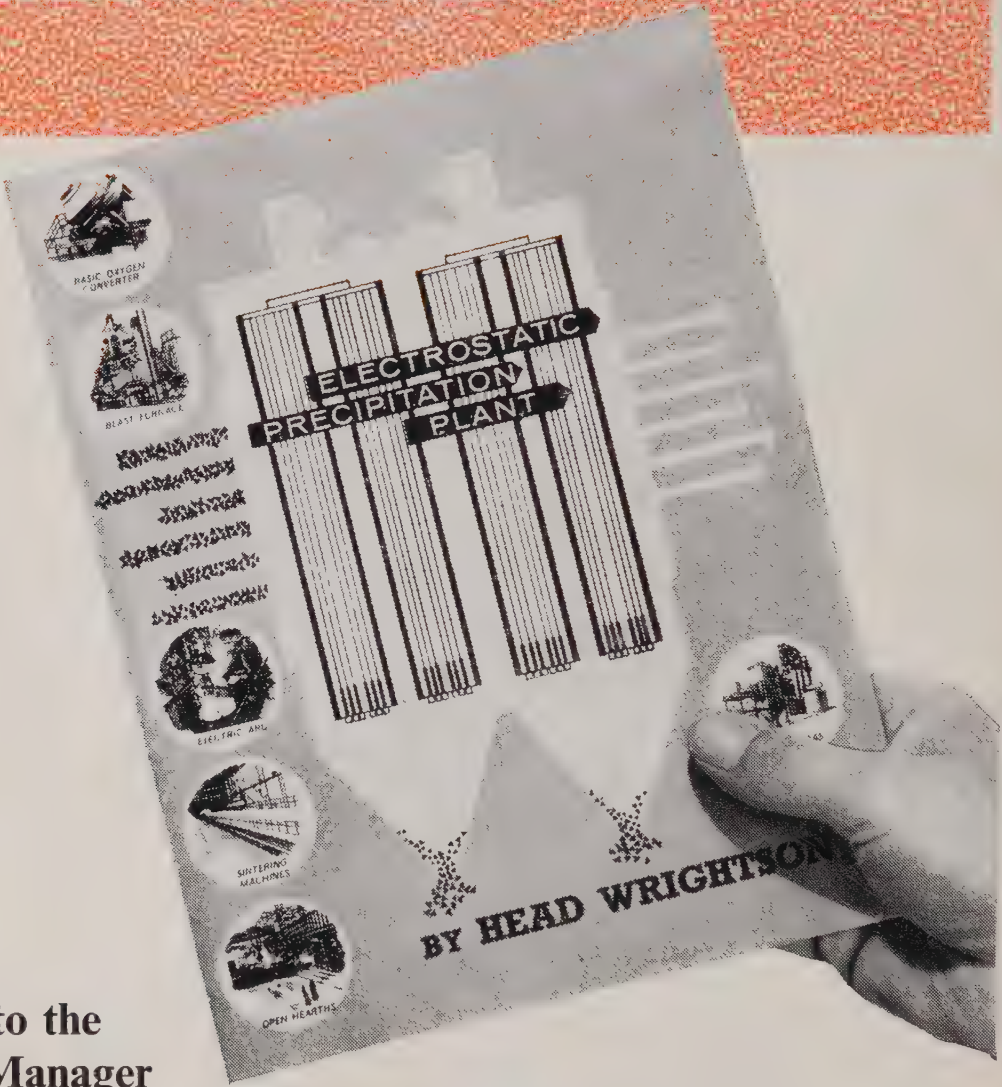

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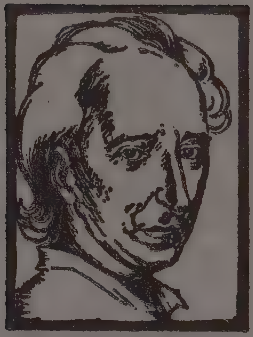

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Proceedings of the 29th Annual Conference

Harrogate

9th to 12th October, 1962

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SUMMARY OF EVENTS

THE 29th Annual Conference of the Society was held in the Royal Hall at Harrogate where 968 members and delegates attended from October 9 to 12.

A departure from convention was the holding of a pre-conference session the day before the official opening. Its theme was "Some Aspects of Air Pollution in the Steel Industry" and both delegates and visitors from the industry gathered to hear the Papers introduced by Messrs. G. H. Wood and F. M. Shaw and jointly by Messrs. R. L. Cooper and J. P. Graham, with Mr. R. G. Hacking in the chair.

Recent Government changes and an unfortunate clash of dates with the Conservative Party Conference prevented the customary appearance of a Minister at the opening session on Wednesday morning but the cordial civic welcome afforded by the Mayor of Harrogate, Councillor G. Norman Morrell, J.P., gave as much pleasure to a full house of delegates as did his friendly visit to the Clean Air Exhibition in the adjoining Exhibition Hall.

After presiding over these cordial formalities our President, Lord Cohen of Birkenhead, delivered the Presidential Address. Both the content and presentation of this Address were outstanding.

In the afternoon session papers were presented from France, Ireland, The Netherlands, West Germany and the United Kingdom on aspects of the international effort to eradicate air pollution. The papers varied widely in their content and it will suffice to say that beside being of great merit and interest they again brought before us the vision of a world council for clean air. Discussion, regrettably, was sparse. The Society's Chairman, Dr. J. L. Burn, presided.

On Thursday morning Dr. J. S. Carter introduced his paper on "The Alkali Works Order 1958". At this session Mr. J. Goodfellow presided and lively discussion ensued. The way in which Dr. Carter presented his paper and replied to the discussion was warmly appreciated.

At the afternoon session the audience was augmented by specially invited parties from local women's organizations and Mrs. D. M. Charlton, O.B.E., presided over a Questions and Answers Session on Domestic Smoke: Smoke Control Areas and Domestic Heating. The panel of speakers consisted of Messrs. P. Draper, N. Hudson, D. N. Maddocks, W. J. S. McKinnell, Cllr. Dr. M. S. Miller, R. B. Partington, F. A. Robinson and A. C. Saword.

On Friday morning at a well-attended final session Mr. S. Cayton introduced a paper on Incineration and Waste Disposal. His Chairman for this session was Mr. T. Henry Turner.

Then followed the customary vote of thanks, on this occasion moved with eloquence and vigour by Cllr. W. A. N. Jones of Birmingham. Reference was made to the Mayor of Harrogate, the officers of the Borough, the President, the chairmen of sessions, the authors, the stewards, the exhibitors, the staff and all those who had laboured to ensure the success of the Conference and Exhibition.

The Exhibition was given a more descriptive title this year—the Clean Air, Fuel Efficiency and Domestic Heating Exhibition. The individual stands were aesthetically pleasing and effective and all concerned agreed that it had been noteworthy and successful.

Social events included an informal "get-together" on the Tuesday evening. The Civic Reception by the Mayor and Mayoress was a delightful occasion and all left the conference with pleasant memories of Yorkshire hospitality.

Presidential Address

by

The Rt. Hon. Lord Cohen,

P.R.S.H., M.D., D.Sc., LL.D., F.R.C.P.

I AM once again privileged to deliver the Presidential Address at the Annual Conference of our Society. Boswell recalls that when Dr. Johnson was told of a gentleman who married very shortly after his wife's death he observed, " It is the triumph of hope over experience ". A second Presidential Address might evoke similar sentiments in your minds, but the fault, if so there be, lies primarily with you and on you must rest the consequences.

When the Conference met in Harrogate two years ago it was privileged to hear an inspiring address from Sir Keith Joseph, then Parliamentary Secretary to the Ministry of Housing and Local Government. Recent Cabinet changes have placed the responsibility for that Department in his hands, and we offer him our warm congratulations and good wishes in so high an office, to which he brings a brilliant mind and outstanding administrative gifts unfettered by the shackles of precedent, an irresistible charm and an urge to contribute to the welfare of this country. Of the problems which confront his Department the hazards and discomforts of air pollution are in this last respect not the least significant.

Last year I drew attention to the chronic poisoning of the air we breathe by dozens of chemical processes characteristic of an advancing civilization, which gives rise often to minor illnesses over the years, but which nevertheless inexorably cripples and kills in the end.[1] Nowadays bronchitis accounts for approximately one-tenth of all illnesses diagnosed by general practitioners and more of a practitioner's consultations and visits are concerned with bronchitis than with any other disease.

The latest available mortality statistics, those for 1960, show that of a total of 526,268 deaths in England and Wales over 50,000 were due to bronchitis and pneumonia[3]; the death rate from pneumonia has not improved in recent years despite the availability of effective drugs because so often pneumonia is the terminal episode in a longstanding chronic bronchitis.

Cancer of the lungs pursues its baneful progress; its death rate increases by about a thousand a year. In 1960 this disease claimed 22,000 victims—over three times as many deaths as those from motor accidents.

Chronic bronchitis is rightly called " the English disease ", for most of the statistical evidence on which the connection between air pollution and this disease is based derives from experience in this country. Yet experience elsewhere supports this association. Particularly striking has been the experience of American military personnel stationed near Yokohama, amongst whom a chronic progressive atypical asthma has become virtually endemic. No infective agent has been found and the relief of symptoms when the victims are moved out of the area, the heavy industry in the neighbourhood, and the amount of smog make it virtually certain that this atypical asthma is a response to a polluted atmosphere.[4] In Belgrade, detailed comparisons of morbidity from typical asthma in different areas have also shown a correlation with variations in atmospheric pollution.[5]

There is evidence also that unexpectedly heavy smog can trigger off asthmatic attacks. A recent report from Australia tells of hundreds of acute asthmatic attacks occurring within a very brief spell as a result of a temperature inversion which prevented the usual dissipation of polluted air; and similar correlations have recently been observed in San Francisco between the sporadic air pollution and the exacerbation of symptoms in chronic bronchitis and emphysema.[6]

In my address last year I touched briefly on the relationship between cigarette smoking and cancer of the lung which originates in the bronchial tubes. Since then the Royal College of Physicians Report on *Smoking and Cancer* has been published. This is a masterly marshalling of the available data pointing to the irresistible conclusion that no prudent person will continue, without weighing the risks, to be an excessive cigarette smoker. The Report did not claim that cigarette smoking was the sole causative factor in lung cancer; indeed, it acknowledged the rôle which atmospheric pollution might play and the College has established a committee to investigate this.

Studies from all parts of the world show that air pollution plays a substantial rôle in the etiology of lung cancer. Comparisons of the incidence of this disease in town and country when they have been adjusted for smoking habits show a significant excess of lung cancer deaths in the urban population over the rural population at every grade of smoking habits. Every study supports this general conclusion, although the degree of variation between urban and rural populations differs considerably. The 33rd Annual Report of The British Empire Cancer Campaign (1955) reports that among non-smokers the urban/rural ratio for lung cancer deaths in that year was about 9 to 1. The larger study reported by Hammond and Horn[7] revealed a less spectacular but still significant difference. In a group of about 180,000 white men aged 50–70 and followed up for a period of 44 months, the incidence rate was 52 per hundred thousand for city dwellers, as compared with 39 per hundred thousand for those living in rural areas. However, since these groups contained both smokers and non-smokers, the findings are perhaps not strictly comparable with those of the report of the British Empire Cancer Campaign.

Moreover, the problem of definition clearly disturbs extensive studies. The person living in the country but near a main road and not far distant from a large factory may be living in a more " urban " environment, as far as the air he breathes is concerned, than many city dwellers. Hence the studies localized to precisely defined and relatively small areas are of great interest and Patno's work[8] which some years ago compared the cancer incidence in sixteen districts of Pittsburgh and showed that lung cancer prevailed in the central business and industrial areas, points the way to a type of study that might usefully be made in large cities. Mills[9] in an interesting survey of lung cancer deaths in greater Cincinnati found that there were highly significant correlations between deaths from lung cancer and three other variables, namely, cigarette smoking, urban residence, and the number of miles driven annually in urban traffic. In a recent analysis of his findings he asserts that " in general, urban residents exposed in urban traffic for over 12,000 miles per year, exhibit over twice the lung cancer incidence rates of those with lesser urban driving mileage". All the available evidence supports his suspicion that this differential has increased in the past few years.

Following the tragedy of the smog in the greater London area of December, 1952 which is estimated to have caused some 4,000 deaths from bronchitis and pneumonia, the Medical Research Council turned its attention to the problem of urban air pollution, and in its recent Annual Report[10] it devotes for the first time a special section to this aspect of its work. In this are reported the results of experimental, clinical and statistical investigations of considerable interest and promise. But there can be no early clear-cut answer to many of the problems of the relation between atmospheric pollution and respiratory disease, and particularly to that of establishing a connection between specific pollutants and specific disease processes. Firstly, one cannot experiment on man, and too often he shows inherited variations in response to different environmental factors; secondly, the time lag of such effects is very largely unknown; thirdly, social conditions and atmospheric pollution are continually changing; and fourthly, as Schepers[11] has succinctly stated "about 3,000 chemical particles have been identified which can be dispersed in air, less than 10 per cent of these we know something about, and less than 1 per cent of that which we know is relevant."

But we cannot await complete understanding before applying the crude but well established knowledge that we already possess. We know that air pollution is a severe hazard to health, although we cannot measure the degree of its severity, nor can we explain the mechanisms involved. Consequently, our aim must be the maximum possible elimination of air pollution. The medical profession has in recent years increasingly recognized the harmful effects of air contaminants, and I can promise on their behalf wholehearted support for the persistent efforts of this Society to prevent air pollution.

The National Productivity Year

I turn now to another though by no means unrelated topic. You will know that our Publicity Committee recommended, and the Council agreed, that we should associate ourselves with the National Productivity Year opening in November, and I have been honoured as President of the Society to accept the office of Vice-Patron of the Year. It is, therefore, appropriate that I should refer briefly to the economic aspects of air pollution and its effects on productivity. It is not possible immediately to translate all these effects into economic terms. Ill health is one example of the difficulty, and offensive odours indeed stenches are another. In some cases estimation of damage is accurate, in others only approximate. If the damage is "total," *e.g.* crops rendered unsaleable, or flowers destroyed, the loss can easily be calculated. But if "partial," *e.g.* corrosion of metals, soiling of curtains, blackening of paint, it may be controlled or prevented, though in economic terms we must clearly balance the cost of the damage due to pollution (which is rarely accurately ascertainable) against the cost of measures to combat or eliminate pollution (which are more accurately ascertainable).

I have earlier discussed those illnesses in which air pollution plays a part, and which result in a direct loss of manpower to national productivity. There are, however, many other sources of loss. Livestock and crops may suffer seriously in polluted areas. There may be corrosion of various materials, especially stone and metals, and their protective coverings, depreciation of objects of merchandise exposed to pollution, a need for more frequent repair and renovation of property, such as buildings, metal structures and paintwork, and also for extra washing and laundry. French statistics provide interesting information. The city dwellers give on an average 50 per cent more clothing to be washed each week than does the rural inhabitant, and it is estimated that the atmosphere in urban areas decreases the life of garments by 1/20th. A coat of paint or paper lasts six years in the country and four years in the town. Builders say that zinc work which used to last for thirty years has now, when exposed to severely polluted atmospheres, to be renewed in four to five years.[12]

Another source of loss is the unburnt residue in chimneys, motors and various engines, which contributes to the general pollution, an example of the waste of mining productivity by the loss of fuel in making smoke. Researches by The British Coal Utilisation Research Association since the publication of the Beaver Report,[13] show that up to 5 per cent of the coal burnt in the open domestic fire is lost in the form of smoke, and this means an annual loss of coal of up to 1,500,000 tons.

Again there is loss of productivity during smoke-fog or smog conditions due to the intensification of the normal harmful effects; at these times there is also interference with all forms of transport in so far as natural fog is made worse or lasts longer because of its smoke content, and there is the wasted electricity due to premature twilight caused by smoke. There is, moreover, the cost in money and manpower directly incurred by the adoption of technical measures for the suppression or reduction of smoke or emission from factories; the increase in cost of electric power due to dust removal and other treatments of smoke from power or nuclear stations; the expenditure in connection with the administrative organization of pollution control; and the costs of medical, agricultural, chemical and physicochemical research which aims at working out techniques for the measurement of pollution, investigating the ways in which pollution affects persons, animals, plants and materials, and studying appliances or installations for the reduction or suppression of various dusts and emanations.

Appendix II of the final Report of The Beaver Committee[13] discusses in detail the economic cost of air pollution, and estimates that the monetary cost was in 1954 at least £250 million a a year, plus £25 to £50 million as the value of the coal lost in producing smoke. Sir Hugh and other members of the Committee have since stated that this estimate was too conservative, and their view is supported by many subsequent publications dealing with the economics of air pollution. This is a cost which is borne by the individual, by industry, by Local Authorities and others. It is fitting that, as National Productivity Year opens, attention should again be drawn to the cost of air pollution and its effect on national productivity through the tying up of manpower, of capital, of materials for repair and renovation, and thus diverting these from more fruitful purposes in the social services, commerce, industry and the professions.

The Burning of Coke

One aspect of the problem of smoke control to which my attention has been directed in the past few months is the use of coke as a smokeless fuel. It is commonly believed that open coke fires give off fumes which are injurious to health, yet if the rapid expansion of smoke control areas is to be facilitated, any doubts about the use of gas coke, which is the cheapest smokeless solid fuel in ample supply for open fires, must be resolved. It appeared to me that both from the medical and the fuel aspects the question should be capable of a firm answer. A careful assessment of studies reported in the literature, consultations with experts, and visiting installations in private homes (since it must never be forgotten that nearly half of all the smoke in the air comes from domestic chimneys, and the proportion is indeed greater in areas where houses predominate) have resolved all my doubts, and I am especially indebted to Dr. P. J. Lawther of the M.R.C. Air Pollution Unit and Dr. A. E. Martin of the Ministry of Health; and to Professor Semple and Mr. Wattleworth of the Health Department, Liverpool, who arranged my visits. I was indeed surprised to find that there were so few complaints; it might however be a good plan to make a survey of the prevalence and nature of complaints based on alleged adverse medical effects of coke fires, and to investigate any which appear to have a rational basis.

The facts, which others have confirmed, derive essentially from the work of Crumley and Fletcher.[14] It is well known that coke fires emit neither smoke nor tar whereas coal emits both, and it is the tarry smoke from coal fires which is the main source of the aromatic hydrocarbons which are found in town air; some of these are known to give rise to experimental cancers.

No such smoke arises from a coke

fire, yet one of the objections raised to coke is that it " gives off fumes ", by which is presumably meant sulphur dioxide (SO_2) because of the smell which is discernible under adverse conditions. Yet flue gases from coal show an SO_2 concentration in the early stages of combustion several times greater than the amount of the SO_2 given off from a coke fire. Why then the objection to coke on account of smell? The total emissions of SO_2 from equal weights of coal and coke when burnt in a fire are the same. It is probably because the smell of SO_2 from coal is masked by the pungent smoke if there is a down draught. Moreover, Crumley and Fletcher, using an openable stove with the fire-doors open, found that in the early phase of combustion of a coal fire there is emitted up to 100 p.p.m. of sulphuretted hydrogen (H_2S)—a most offensive smelling gas—whereas coke emits only a trace.

It has been said that the risk of carbon monoxide (CO) poisoning from a coke fire is not a negligible hazard. Yet the flue fumes from both coke and coal show similar concentrations of CO (0·1 per cent to 0·25 per cent). This belief probably derives from coke being more commonly used in free-standing closed stoves which might have leaky flues, but on open fires coke presents no greater hazard than coal.

A coke fire burns at a higher temperature and gives out greater heat, more uniformly. But the higher temperature of combustion means that more of the sulphur is oxidized to sulphur tri-oxide (SO_3). A brightly burning coal fire emits only half the quantity of SO_3 compared with a coke fire; indeed, a smoking coal fire emits no SO_3. The SO_3 forms with the water vapour of the atmosphere small droplets of sulphuric acid but this emission is very small, and in none of the houses visited, including one in which the occupant had been retired from work because of chronic bronchitis, was there any complaint of irritant fumes.

There seem to be two sources from which popular bias against coke fires is derived. Firstly, from the experience of the emissions from coke used in closed domestic boilers; the flues of these boilers can be inadequate, the lids can be removed, and the escape of gases into the air is therefore comparatively easy and commonly occurs. Secondly, since the amounts and concentrations of the gases which arise in the combustion of any fuel vary not only with the fuel but also with the different combustion appliances, and the conditions under which the fuel is burned, it is essential that these should be satisfactory. If unsatisfactory, coke will be regarded as an inferior fuel; yet coke is not only as satisfactory as coal, but it is also more economical, and since it does not carry the long-term hazards and economic burdens of atmospheric pollution due to coal, it is for domestic heating the more satisfactory.

The dissemination of this knowledge is a problem which local authorities face and must solve. They must ensure not only the provision of appliances and the necessary conversions for smokeless combustion but must also see that these appliances are properly used. To this end, written and oral instructions are not enough. Personal demonstrations must be arranged, recently installed appliances must be inspected to ensure that they are working satisfactorily, and an adequate supply of smokeless fuel should be available at the dealers.

Some local authorities have provided demonstration houses in which the various forms of smokeless combustion can be seen, and their appropriate use and indications can be explained.

Smoke Control Area Grants

There is one aspect of this problem on which I cannot claim expert knowledge. I refer to it because it is frequently raised by Medical Officers of Health with whom I have discussed the need for more rapid implementation of the Clean Air Act. All seem agreed that there is considerable irritation and frustration arising from a lack of beneficial incentives to owners and occupiers who have voluntarily converted their houses to smokeless combustion. These people have acted in advance of official approval, many from idealistic motives based on improvement of their environment, and some for practical reasons connected with timing alterations to their houses in one operation to avoid double inconvenience. There are two groups of these good citizens; firstly, there are those who live in declared smokeless areas where the appliances have been installed prior to confirmation or without written permission; and secondly, there are those houses situated in the fringe areas of smokeless zones whose occupiers have been moved by propaganda to wish to change to smokeless combustion at the earliest possible moment.

If it were possible to recognize by a grant the co-operation and goodwill of such householders, it would speed up smoke abatement in advance of the smoke abatement programme. In Liverpool already 800 cases have been reported of people who have spent sums varying from £10 to £100 and who have received no grants, whilst their neighbours, who have waited until the change is compulsory, have received 70 per cent of the cost. The number of aggrieved people is constantly increasing in the more progressive local authority areas, and yet these authorities cannot reasonably contemplate a discretionary payment because of the large sum of money which is potentially involved, for should the Local Authority consider paying these claims, the full amount would have to be borne by the rates without Exchequer Grant Aid, as such claims do not qualify under the Clean Air Act, 1956.

No one familiar with the problem will underrate the Minister's difficulties in defining criteria which will ensure appropriate control, but these should not prove insuperable. For example, practical criteria might include firstly the production of receipts of recent origin; secondly, the signing of an agreement undertaking to obey certain regulations; and thirdly, the restriction of payment to people in Smoke Control Areas or within a specified distance of declared Smoke Control Areas. It is true that a short interval may well elapse before the occupiers burn solid smokeless fuel, but many would convert to gas or electricity immediately if the grant were available.

As you well know, the House Purchasing and Housing Act, 1959, allows grant aid for improvement to houses. The " Standard Grant " scheme allows as a right the cost of up to a maximum of £155 for installing five basic improvements, namely, a bath or shower, a wash-hand basin, a water-closet, hot-water system, and a food store; if it were possible to add to this list ranking for Grant Aid, the phrase " the installation of an approved smokeless appliance ", the work of conversion in advance of Smoke Control Orders would undoubtedly be expedited.

The " Discretionary Grant " scheme allows for conversion of houses into flats up to a maximum grant of £400. Here again it would be advantageous if under this scheme the Local Authority were to insist on approved appliances being installed as one of the twelve requirements. There is a clause under this scheme which states that a house should be provided with adequate means of supplying hot water for domestic purposes. The Local Authority should, therefore, take every opportunity of insisting upon the installation under this scheme of approved smokeless appliances.

I have dealt with but a few of the topics of current interest which must be exercising all our minds, and there are several others which would have merited public reference had time allowed. But I have already spent my allotted time, and even your President cannot " bid time return ". May I, therefore, in concluding this address, firstly, thank you once again for the signal honour of being your President for the past two years.

No one who shares with Disraeli the belief that, " The health of the people is really the foundation upon which their happiness and all their power as a state depend ", can fail to be proud of leading such a Society in the work which it has undertaken. Slowly, all too slowly, the implementation of the Clean Air Act continues. Our tasks are twofold; firstly, we must educate the public and those who represent them in Government to realize the vast damage and enormous cost of air pollution; and secondly, we must prod the Government repeatedly to greater effort and generosity. For the Clean Air Act must be accepted not simply as a statutory responsibility, but as a challenge and a great opportunity.

A year ago Lord Hailsham, the Minister for Science, ventured to prophesy that by 1984 " the air even in industrial areas will be clear of smoke and dirt ". All who seek to achieve an atmospheric Utopia must so increase their efforts as to ensure that his crystal-gazing is as effective as his bell-ringing.

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SOME ASPECTS OF AIR POLLUTION CONTROL IN THE STEEL INDUSTRY

*by A. H. Wood**

Introduction

THIS paper is concerned solely with a number of processes in the iron and steel industry recognized as presenting special technical difficulties in air pollution control and, in consequence, registered within the framework of the Alkali Acts and Orders. Iron founding and coking operations are not discussed since they form the subjects of separate contributions to this technical session.

Many important technical changes have taken place in the steel industry during the last decade, the most far-reaching of which have been the extensive pre-preparation of the blast furnace charge, the changing pattern of fuel consumption, and the impact of high purity oxygen, available in bulk quantities, on steelmaking processes. The last mentioned has enabled changes to be made in the traditional bottom blown converter, open hearth and electric arc furnace techniques, and has also led to completely new processes being developed.

Ore Preparation and Ironmaking

Ore Preparation

Until fairly recent times, preparation of iron ore prior to its being charged to the blast furnace was of a rather rudimentary nature involving the separation and subsequent discarding of ore " fines " which, if charged, choked the furnace and reduced iron output. Modern practice recognizes the benefits to be gained from thoroughly preparing the ore and other materials, the ore being crushed to an optimum size —in the range $\frac{3}{8}$ inch to 2 inches—the arising fines being agglomerated by partial fusion in a sintering machine before charging to the blast furnace. In the case of lean indigenous ores, it is advantageous to crush all the ore to minus $\frac{3}{8}$ inch and sinter in entirety before charging to the blast furnace.

The most common type of sinter machine uses a travelling grate—typically 6-8 ft. wide and 100 ft. or more in length—on which a layer of ore fines and coke breeze (and in some cases limestone) is laid. The coke breeze is ignited and burned with air which is sucked downwards through the mixture by a large induced draught fan; the heat generated by the coke serves to drive off moisture, carbon dioxide and a proportion of the sulphur, and to fuse the mixture into a clinker-like substance which is broken, screened and cooled at the discharge end of the sinter strand.

There are two main sources of pollution; firstly, the dirty waste gases from the combustion and sintering reaction itself, and secondly, grit and dust arising at the discharge end.

Sinter is a highly abrasive material and, in the absence of cleaning plant upstream of the fan, the wear-rate of the main exhaust fan blades is intolerably high. Gas flow rates may be as high as 350,000 $ft.^3$ min: it is thus important to minimize pressure losses in the exhaust system and it has been usual to employ only low pressure loss cleaning systems such as settling chambers or cyclones or, in some cases, multi-cyclones, involving a pressure drop in the range $\frac{1}{2}$ to 3 in. water gauge, although electrostatic precipitators have recently been favoured for cleaning the windleg gases at a number of plants. Inlet dust loadings vary from 0·1 to 0·6 grain/ft.^{3}, and cleaning efficiencies of up to 90 per cent. (*i.e.* 10 per cent. residual dust loading) are attained in the newer installations. After being de-dusted, the gases are discharged from a high chimney, the actual height of which is appropriate to the quantity of sulphur dioxide emitted.

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* British Iron and Steel Federation.

Dust at the discharge end has presented a two-fold problem in that it is not a " ducted " emission and must be contained before it can be collected. Inefficiency in a containment system may be due to its inability to contain the dust, or the dust may be contained only by virtue of pulling in vast quantities of tramp air and increasing cleaning cost or impairing the efficiency of the cleaning unit. With increasing experience, containment systems at the discharge end of sinter plants are being improved and recent installations are highly satisfactory. Dust loadings at the discharge end, prior to the cleaning unit, are usually in the range 5-7 grain/ft.^{3} but in some plants reach 10-12 grain/ft.^{3} The dust particles are mainly quite large in size and cyclone or multi-cyclone cleaning units have been widely employed, giving cleaning efficiencies around the 90 per cent. mark. Because of the very large volume of gas involved even this standard of performance is barely adequate for the larger machines and a number of the more modern units are fitted with electrostatic precipitators giving cleaning efficiencies of 98 per cent. or so (2 per cent. residual dust loading).

The production of sinter in the U.K. in 1961 amounted to 14·6 million tons and, at the end of the year, sinter machines of various types were in existence at 24 works. Some further increase in sinter production must be expected in the future and this realization has led to the adoption of very high standards of cleaning for new plants.

Ironmaking

Sinter, together with prepared ore, limestone as necessary, and coke are charged into the top of the blast furnace through a double bell system designed to minimize leakage of dirty gas. Air is blown upwards through the furnace burden, burning the coke and smelting the ore. The products of the furnace are molten pig iron and slag which are tapped from the lower part of the furnace and blast furnace gas, containing 25-30 per cent. of carbon monoxide, which leaves the top of the blast furnace and passes into an elaborate gas cleaning plant. At most works, virtually the whole of the gas is used as a low grade fuel for underfiring coke ovens, for boiler firing and also for heating the blast furnace stoves (the hot brickwork of the stove then serves to heat the air blast to the furnace. There are either three or four stoves per furnace going " on gas " and " on blast " in rotation). Dirty blast furnace gas has a dust loading of 5-10 grains/ft.^{3} and, in this condition, is clearly quite unsuitable for most applications. Where plant is designed to operate continuously for many years, *e.g.* coke ovens, a very high standard of gas cleanliness is essential in order to eliminate dust blockages, and multi-stage cleaning must be employed. A typical blast furnace gas cleaning installation at an integrated works consists of a dustcatcher and gas washing tower in which the dust loading is reduced to 0·15-0·3 grain/ft.^{3}; these are followed by an irrigated electrostatic precipitator cleaning to 0·002-0·01 grain/ft.^{3}

A blast furnace is normally in continuous operation and at integrated works where other departments are not on a continuous working week also there may be a surplus of gas at weekends. With gas production at the rate of say 5 million cubic feet per hour per furnace, storage of all gas produced during the weekend is completely impracticable, and the only solution is to discharge the surplus to atmosphere. It is becoming increasingly common practice to bleed gas only in the fully cleaned condition.

The requirement for blast furnace gas at some of the non-integrated works is limited and the gas cleaning plant does not reach the high standard of efficiency attained at integrated works. The position is being improved by the extension or replacement of cleaning units at some furnaces. A further factor has been the replacement of production from obsolete furnaces by additional output from modern units.

The blast furnace is an enormous chemical laboratory, the detailed operation of which is not always predictable. From time to time a furnace may operate erratically, with the burden sticking in the furnace shaft for a time then falling suddenly and producing violent pressure fluctuations in the furnace and associated gas cleaning plant. Pressure relief valves are built into the gas offtakes in the furnace top structure as a safeguard against damage to the plant and explosion hazard. When a large pressure build-up occurs the valves open automatically, releasing dirty gas to atmosphere. The use of a sintered, or other form of fully prepared, burden has many attractions, not the least of which is that it promotes smooth working of the furnace and substantially reduces the incidence of slipping and emergency bleeding of dirty gas to the atmosphere. Although tremendous strides have been made, it is too much to expect that periodic slipping and emergency bleeding of gas will be eliminated entirely.

Much of the particulate pollution from iron works is coarse and settles out quite close to the point of emission as is shown in Table 1, and the use of a little foresight in selecting the location of houses relative to existing works can pay handsome dividends by reducing the nuisance value of unavoidable pollution.

Steelmaking

The steelmaking operation involves the removal by oxidation of some 7 per cent. of impurities from the pig iron used in the steelmaking furnace charge, and raising the temperature of the bath to produce a liquid slag capable of removing the impurities. Oxygen for these reactions is supplied either as solid iron oxide, or in gaseous form—traditionally as air—and the required heat is provided either by the oxidation process itself (as in the Bessemer converter processes), or by an external fuel (as in the open hearth and electric furnace processes).

Classical Processes not using High Purity Oxygen

Bottom Blown Converter.—A blast of air is forced upwards through a shallow bath of molten iron contained in a converter of the type shown in Fig. 1 having a capacity in the range 10-60 tons. In operation, the vessel is turned down to receive its charge of molten iron, blowing commences and the vessel is turned up to the vertical position. The blow lasts for about fifteen minutes, by which time the impurities have been eliminated and the finished steel is ready for pouring. The converter waste gases, which burn with tongues of flame up to 50 feet in length and attain a temperature of 2,000°C. during carbon removal, are ducted to atmosphere via a wide chimney, entraining large quantities of tramp air in the process so that as much as 100,000 ft.^{3} of gas is emitted from the chimney per ton of steel produced. Ejections from the converter

TABLE 1

Variation in rate of solids deposition with deposit gauge site at an iron works.

Area of measurement	*Solids deposition rate—arbitrary units*
Adjacent to sinter plant	100 (mean of 5 gauges)
Adjacent to coke ovens	86 (mean of 5 gauges)
Enclosing both sinter plant and coke ovens	24 (mean of 11 gauges)
Near works' boundary	6 (mean of 10 gauges)

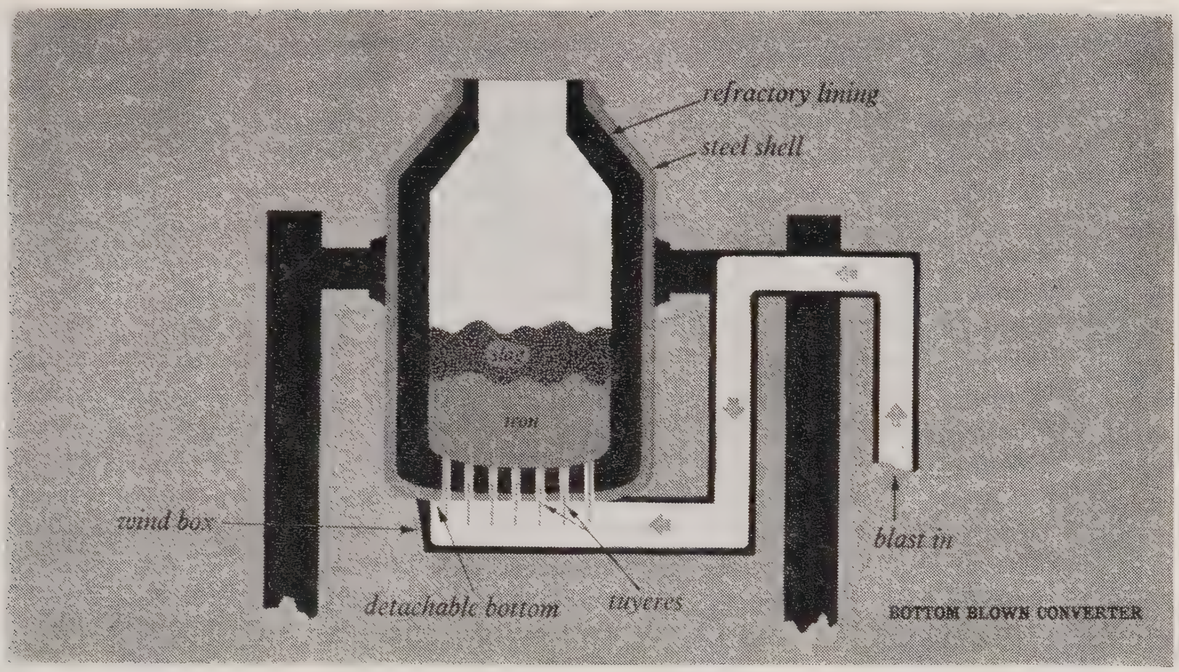

Fig. 1

amount to $1\frac{1}{2}$-2 per cent. of the charge, most of the ejected material being relatively heavy " spittings " which fall inside the chimney; particles of finely divided iron oxide fume are also entrained, the concentration being particularly high during the last few minutes of the blow giving the chimney plume a characteristic red-brown appearance; up to 0·2-0·3 per cent. of the charge weight is emitted as fume.

A high proportion of steel produced in Germany, France, Belgium and Luxembourg is made by the basic Bessemer process, and in recent years several works there have experimented with modified chimneys fitted with cylcone cleaning plant. Mass emissions to atmosphere have thereby been appreciably reduced but such systems are not capable of removing fume and in consequence have negligible effect on the appearance of the plume. One co-operative venture in Germany has employed a waste heat boiler and dry electrostatic precipitator cleaning unit with a quite high degree of success.

One obstacle to a really satisfactory solution of the problem is fundamental to the process: blowing must commence as the vessel is raised from the horizontal position in order to prevent molten iron running into the tuyeres in the bottom of the converter, and it must be continued until the vessel is turned down to the horizontal position for pouring the steel. It has so far been completely impracticable to design a hood which is capable of containing the waste gases during the turn-up and turn-down periods.

Of the five bottom blown converter installations in the U.K., two of them rely on the traditional air blast.

Open Hearth Furnace.—Open hearth furnaces have capacities in the range 50 to 500 tons; various practices are employed ranging from a charge of 80 per cent. molten iron and 20 per cent. cold scrap at one extreme to one consisting of 15 per cent. cold pig iron and 85 per cent. cold scrap at the other. The flexibility of the open hearth furnace coupled with the high quality of the product has given it the lion's share of world steel production. In the U.K., 83 per cent. of the steel output in 1961 came from open hearth furnaces. The process as traditionally operated has two major disadvantages; firstly it is slow, with a tap-to-tap time of 8-15 hours, and secondly it has a high fuel consumption—in the range 40-50 therms per ton of steel. Producer gas was at one time widely used as a fuel for these furnaces but has now been largely replaced by liquid fuels or coke oven gas.

Open hearth furnaces are fired from each end in turn, reversals taking place every 20-30 minutes. The combustion gases pass over the bath and out of the furnace to a chimney via a slag pocket, a refractory brick lined heat exchanger (or checker) and usually a waste heat boiler. These serve to remove the larger entrained particles from the waste gases, the dust content of which in the case of non oxygen practice varies between 0·05 and 0·25 grains/ft.^{3} after the waste heat boiler. This level of emission has been regarded as acceptable without resort to gas cleaning techniques.

Electric Arc Furnace.—In 1961 electric arc furnaces were responsible for about 7 per cent. of U.K. steel production. At the end of the year, there were 185 such furnaces in existence in the industry mainly small in size and devoted to production of alloy and special steels and small steel castings. Only six furnaces had a capacity of more than 40 tons.

Arc furnaces are almost invariably charged with cold scrap. The heat for melting is provided electrically by an arc struck between three graphite electrodes which are introduced into the furnace through holes in the roof. Since the heat is supplied electrically rather than by combustion of a fuel with air, the furnace is closed and the volume of effluent gases produced is small compared with those in other processes. Where oxygen is not used there has been no cause to employ cleaning plant, although in some cases dust containment hoods and air extraction systems have been used in order to improve working conditions for the furnace crews.

The Impact of Oxygen

The arrival on the scene of tonnage oxygen, *i.e.* supplies of high purity oxygen in bulk at relatively low prices, in the last decade has completely changed the steelmaking picture, leading to the development of three completely new converter steelmaking techniques—the LD, Kaldo and Rotor processes—all using a jet of pure oxygen directed at the surface of a charge of molten iron, and consuming 2,000 ft.^{3} or so of oxygen per ton of steel made. At the same time, it became technologically possible to introduce major modifications to the traditional processes.

When pure oxygen is used for refining, *i.e.* for removal of impurities from molten iron, tremendous quantities of heat are liberated—100 tons of pig iron contains as much carbon as 4-5 tons of coke, as well as other heat producing elements. These are burned in a matter of a few minutes and local temperatures approaching 3,000°C. may be attained. These high temperatures result in the formation of large quantities of iron vapour and droplets which are subsequently oxidized to iron oxide fume particles, typically in the size range 0·00004-0·000002 inches in diameter. This fume is entrained by the stream of waste gases giving rise to the highly coloured red-brown chimney plume which has appeared in all the world's major steelmaking centres in the past few years.

Various techniques have been used to suppress fume formation and some success has been experienced by using an oxygen/steam mixture, which tends to reduce reaction zone temperatures. However, in the present state of knowledge, the only way to achieve a clean stack with the oxygen steelmaking processes is by the use of high efficiency gas cleaning equipment such as electrostatic precipitators, bag filters or high energy wet scrubbers. The outlet loading aimed at is the equivalent of 0·05 grain/ft.^{3} at a gas temperature of 60°F. and a pressure of 30″ mercury—a perceptible, but not visually objectionable, degree of pollution.

Because of the small particle size of the fume from oxygen steelmaking processes, the light-obscuration or reflection powers of even a small mass concentration are tremendously high compared with the same mass of grit or coarse dust. A doubling of the loading from the generally permitted level of 0·05 grain/ft.^{3} to 0·10 grain/ft.^{3} causes the plume to take on quite a heavy appearance: above this level, the visual appearance might, quite wrongly, suggest that no cleaning had been attempted. Taking a specific example; if the initial dust and fume loading in the waste gases is 10 grain/ft.^{3} a cleaning efficiency of 99½ per cent. is required to meet the permitted residual outlet loading of 0·05 grain/ft.^{3} An efficiency of 99 per cent, giving a residual loading of 0·1 grain/ft.^{3}, would be unsatisfactory and, in this case, anything less efficient would be a waste of time and money.

This raises a point in connection with cleaning plant terminology; the difference between 99½ per cent. and 99 per cent. efficiency is numerically small, but the difference in attainment is considerable. Expressing the performances in terms of residual dust loadings—½ per cent. and 1 per cent.—indicates the difference in attainment (and no doubt in cost) with much greater clarity.

Converter Steelmaking

(1) *Bottom Blown Converter.*—By using a blast enriched to an oxygen level of 30-35 per cent. instead of the 21 per cent. of normal air blowing time required can be reduced by one third, and in some qualities of steel, the reduction in nitrogen pick up from the blast may result in an improved quality of steel. Unfortunately, oxygen enriched blast leads to a marked increase in fume concentration—although not necessarily to an increase in total weight of material emitted from the vessel per ton of steel made. By using a mixed blast of oxygen and steam, air pollution can be reduced compared with the traditional air blown basic Bessemer converter: a blast of this composition enables deep-drawing steels of the highest quality to be produced and has been used at several U.K. works. The VLN steel-making process, developed by The Steel Company of Wales, uses an oxygen steam mixture throughout the entire blowing period.

The bottom blown converters in use at five works in the U.K. steel industry were responsible for nearly nine per cent. of the industry's total steel production in 1961. It has already been indicated that no completely satisfactory solution of the air pollution problems associated with bottom blown converters has yet been devised: this fact, coupled with other considerations, is in some cases leading to their replacement by LD converters, a process in which containment of the waste gases is more straightforward since there is only one blowing position.

(2) *LD Converter.*—Shown diagrammatically in Fig. 2, this is undoubtedly the simplest of all steelmaking vessels and units of up to 250 tons capacity are under construction in the U.S.A; the largest size of vessel at present envisaged for the U.K. industry is 110 tons.

The vessel receives its charge of molten pig iron and a high speed jet of pure oxygen is directed at the surface of the charge, penetrating deeply and oxidizing the impurities in the iron. Oxygen blowing time is in the region of 20 minutes, with oxygen consumption of about 2,000 ft.^{3} per ton of steel made. Total cycle times vary from 35-60 minutes depending on the type of iron and the size of vessel.

The gas issuing from the mouth of the vessel contains up to 90 per cent. carbon monoxide during the period of carbon removal: the gas is mixed with air and the carbon monoxide burned in a water cooled hood, producing temperatures in the region of 1,800-2,000°C. In some cases, notably in North America, no attempt is made to utilize the heat in the gases; they are sprayed with water and cooled to a temperature suited to the particular type of gas cleaning equipment used—venturi type scrubber or electrostatic precipitator. Two other types of cooling system are in use in various parts of the world, the first using a waste heat boiler to cool the gases to 800-1,000°C. followed by direct cooling with water. In the second type the gases are cooled to 250-300°C. by

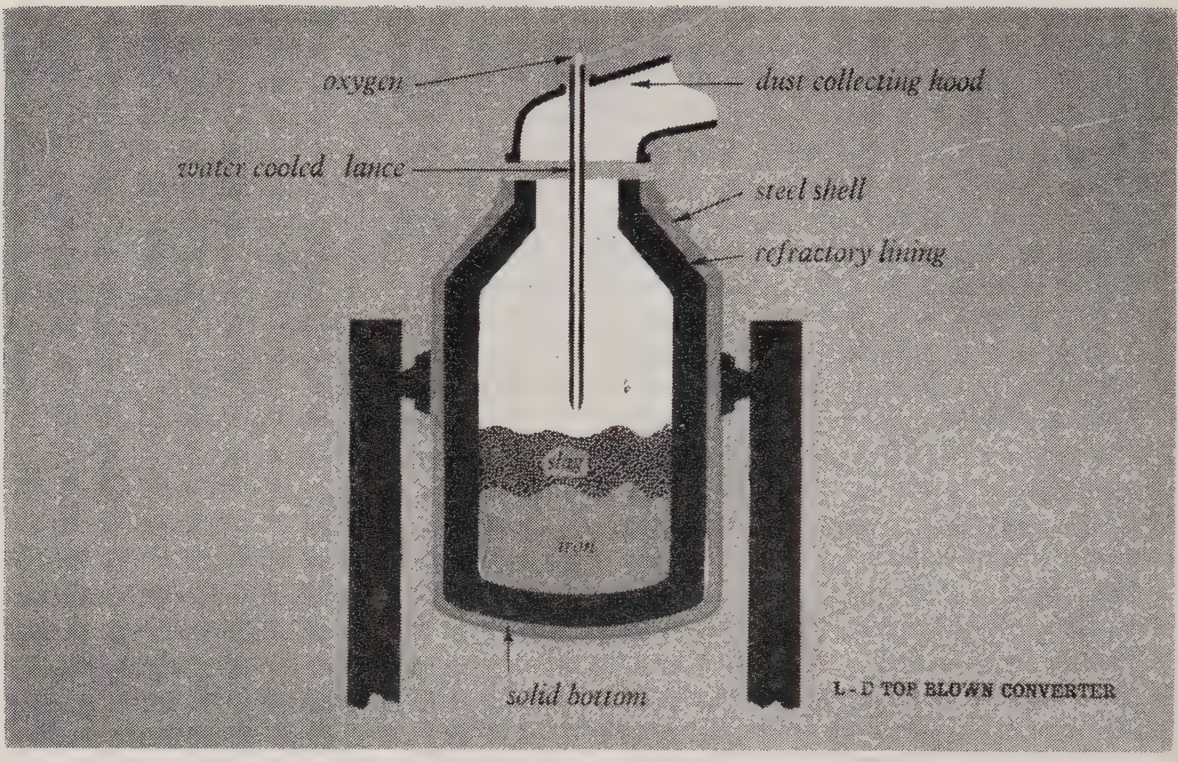

Fig. 2

waste heat boiler. In these cases too, venturi type scrubbers or electrostatic precipitators are used for gas cleaning.

Within the framework described, the choice of gas cooling and cleaning system depends on many local factors—requirement for steam, cost of fuel, availability of water, and availability of capital. Because some systems are high capital cost, low operating cost installations, whilst others are the reverse, the last mentioned factor is clearly of the greatest importance when selecting gas conditioning and cleaning plant.

Six works in the U.K. industry have either installed or are installing LD type vessels. In some cases, the waste heat boiler will cool the waste gases to the 800-1,000°C. range whilst in others the boiler cools them to the 250-300°C. range. In some cases, gas cleaning will be carried out by electrostatic precipitators, in others by venturi type scrubbers.

(3) *Kaldo Converter.*—This vessel is shown diagrammatically in Fig. 3. Units up to 130 tons capacity are under construction: the charge is mainly molten iron and in the actual steel-making position the vessel is capable of being rotated at speeds of up to 30 revolutions per minute. A jet of high purity oxygen is directed at the surface of the charge and refining takes place at a rate determined by the oxygen flowrate, the position of the oxygen lance and speed of rotation of the vessel. Blowing times are typically between 30 and 45 minutes, and cycle times are 1-1½ hours.

The carbon monoxide given off by the charge during refining is, in large measure, burned within the vessel and gives up much of its heat before leaving it. As the carbon monoxide is burned in the vessel with pure oxygen instead of with air after leaving the converter, the volume to be cleaned is much less than in the case of the LD converter. Because of the small gas volume and relatively low temperature, insufficient heat is carried away by the waste gases to make it worthwhile contemplating heat recovery by waste heat boilers, and cooling is to a large extent direct by water sprays. All three Kaldo installations under construction in the U.K. will employ electrostatic precipitators to clean the waste gases,

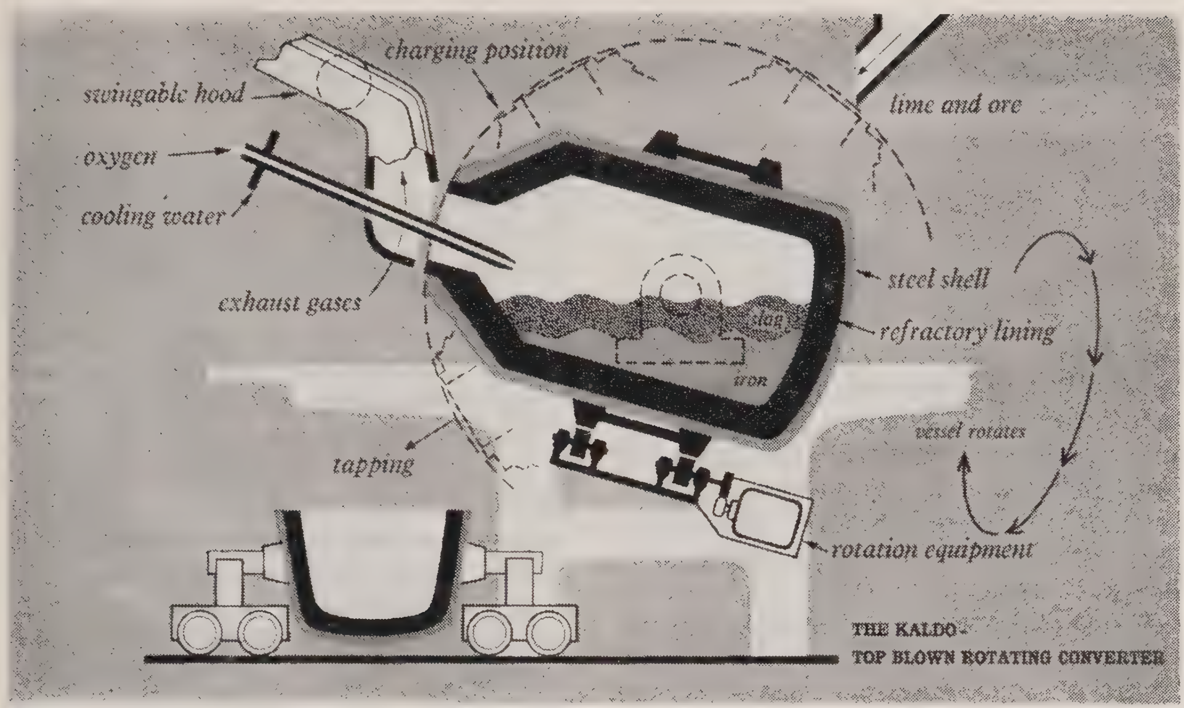

Fig. 3

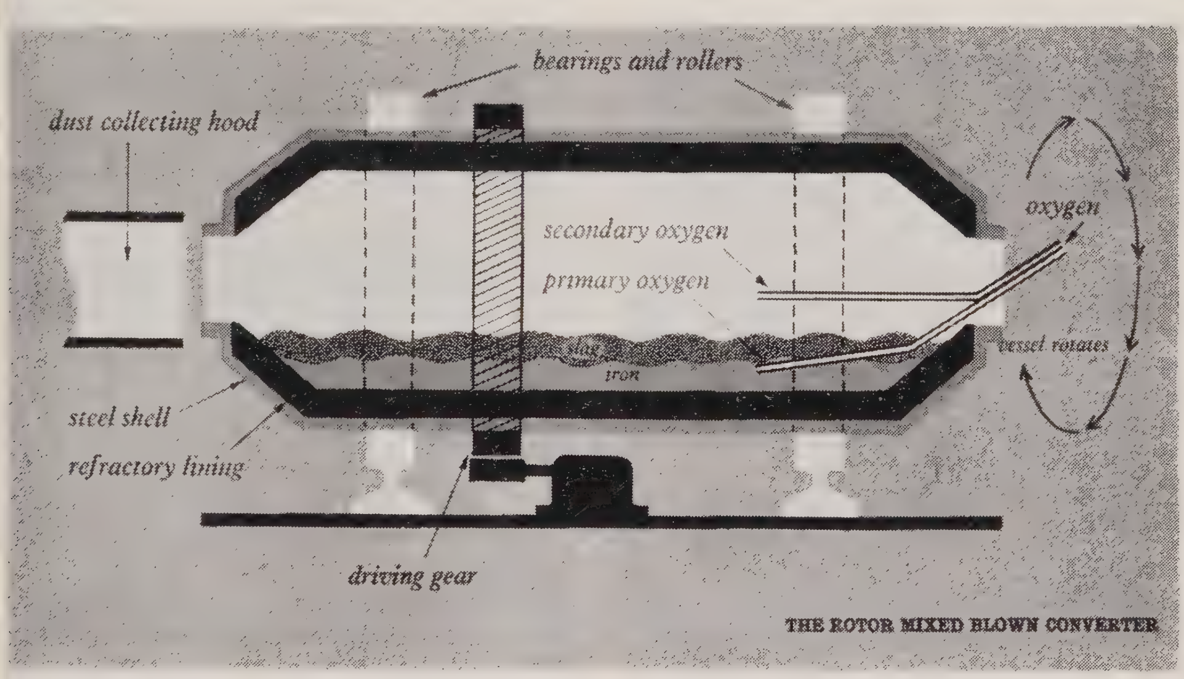

Fig. 4

giving outlet fume concentrations of 0·05 grains/ft.^{3} or better.

(4) *Rotor Converter.*—Shown diagrammatically in Fig. 4, this vessel was developed primarily as a pre-refining unit, the refined iron then being made into steel in a conventional steelmaking unit. The process later proved itself capable of making good quality steel and is so employed at several works in the world.

So far as air pollution problems are concerned, there is a marked similarity between the Rotor and Kaldo processes. The carbon monoxide is again burned within the steelmaking vessel, and oxygen rates and cycle times are similar to those applying to the Kaldo process.

Only one works in the U.K. steel industry has adopted the Rotor process and in this case, a venturi scrubber is used to clean the exhaust gases to better than 0·05 grain of fume per cubic foot of gas.

Oxygen Open Hearth Furnace

Where oxygen is used merely to assist combustion of the fuel, there is no change in the level of particulate emissions compared with the non-oxygen open hearth process and cleaning plant has not been regarded as necessary. Where, as is now frequently the case, oxygen lances are used, fume concentrations may attain the levels of the oxygen converter steelmaking techniques.

Two different practices may be mentioned. In cold charged furnaces using a high percentage of steel scrap, oxygen may be used at a quite modest rate for only ten to twenty minutes: in this type of practice, oxygen consumption may be up to about 180 ft.^{3}/ton of steel although 100 ft.^{3}/ton would be more typical. In hot metal practice, oxygen consumption for refining may be as much as 1,300 ft.^{3}/ton of steel, and oxygen lancing lasts for as long as four hours per charge, with peak fume concentrations reaching 4-7 grains/ft.^{3} There is no doubt that such a practice, used regularly, must require the fitting of high efficiency cleaning equipment.

In most applications of cleaning plant to open hearth furnaces, dry electrostatic precipitators have been preferred, although one furnace in the U.K. has been operated with an irrigated precipitator, and one with a bag filter; whilst in the U.S.A., a venturi scrubber has been employed in one case. The presence of sulphur oxides in the flue gases necessitates the extensive use of stainless steel or other corrosion resistant materials where wet cleaning methods are employed: trouble with acid attack has also been experienced when using bag filters, although this has been overcome to a large extent by resort to glass fibre bags. Power costs associated with bag filter units, which have a pressure loss of 4″-6″ water gauge, tend to be prohibitively high when large volumes of gas have to be cleaned on a continuous basis, such as is the case with open hearth furnaces.

Extensive air infiltration occurs in the regenerators, waste heat boiler and flue system of the normal open hearth furnace; so much so that one third, or even a half, of the final gas volume may be " tramp " air. In the case of oxygen lanced furnaces, leakage increases the capital and operating costs of gas cleaning plant enormously compared with a " gas-tight " exhaust system, and in addition seriously impairs regenerator performance. The difficulties of making and maintaining a gas tight brick structure, the temperature of which regularly fluctuates over some hundreds of degrees, are formidable, but a determined and successful attempt to prevent infiltration has been made by the Appleby-Frodingham Steel Company at Scunthorpe, where the regenerators and much of the waste gas system of the Ajax—modified tilting open hearth—furnaces have been encased in steel plate.

Waste gas volume and fume loadings vary appreciably throughout the course of the steelmaking cycle. Where each furnace in a melting shop has its own cleaner, capable of dealing with peak gas volume and dust loading, the cleaning unit is grossly under-employed for much of the cycle. The total cleaning capacity required can be reduced by bringing the gases from several furnaces into a common main and a central cleaning plant since, for other reasons, the furnaces are operated in such a way as to avoid " bunching ". By this means, peak loading at the inlet to the cleaning plant may be reduced by 50 per cent. compared with a system using a separate cleaner per furnace. There are, as always in practice, advantages in each system and the choice of what is best depends on local circumstances. One works in the U.K. industry has adopted a common main system for a number of open hearth furnaces whereas at other works individual cleaners have been preferred.

Electric Arc Furnace using Oxygen

This furnace presents one of the diminishing number of problems still regarded as not yet completely solved *technically*. Close-fitting hoods over the door, tapping spout and electrode holes operate reasonably well on small furnaces—up to say five or ten tons capacity—using oxygen and, in conjunction with high efficiency cleaning equipment, give satisfactory results. In the case of the larger furnaces, efficient containment is effected only by pulling in inordinately large volumes of tramp air which results in prohibitively high cleaning plant costs. The high temperature of the gases leaving the electrode holes can lead to distortion of the hoods, involving heavy maintenance costs or alternatively to a rapid fall in efficiency of containment. It seems unlikely that close fitting hoods will be installed on any further large furnaces, although various measures are being taken at furnaces already fitted with hoods which may lead to some improvement in performance. The system does possess the advantage that the carbon monoxide issuing from the furnace as a result of the refining operation is fully burned to carbon dioxide and no explosion hazard arises: the technique can also be used during the reducing slag phase of alloy steels production without adverse effect on the steelmaking operation.

The desire to have clean conditions around large furnaces even during oxygen lancing and at the same time minimize gas volumes at the cleaning plant has led to the development of a direct extraction technique using an exhaust duct let into the roof or side wall of the furnace. The degree of suction applied can be controlled either manually or automatically so that it is just sufficient to prevent fume leakage from around the doors and electrodes. An appreciable fraction of the combustibles emitted during the melt down and oxygen lancing periods leave the furnace in the unburned condition and it is widely, although not universally, accepted that this presents an explosion hazard which should be eliminated by burning the gases under controlled conditions in a combustion chamber, the gases then being cooled either in a spray box or in an indirect heat exchanger, followed by cleaning in an electrostatic precipitator, bag filter or venturi type scrubber.

This system of extraction is in operation on several furnaces at the present time and further installations are due for commissioning later this year which, it is expected, will fully establish the economics as well as the technology of direct extraction. Here again the choice of common main and central cleaning plant, or individual cleaner, for each furnace will depend on local circumstances.

Scarfing

The surfaces of steel ingots, slabs, blooms and billets may contain surface defects which can best be removed by burning out with pure oxygen. This operation, known as scarfing, was at one time carried out by hand torches after the steel had cooled and been inspected to find the defective areas. Hand scarfing is to some extent being replaced by machine scarfing in the rolling mill production line. These machines are fitted with rows of oxygen/fuel burners capable of scarfing all faces of the steel piece simultaneously. Unfortunately, the temperatures and quantities of oxygen associated with the automatic scarfing process are high enough to generate iron oxide fume in quantities requiring the use of gas cleaning equipment.

Scarfing is an intermittent process carried out perhaps every 2-3 minutes and lasting 20-30 seconds. The dirty gases are sucked into a gasholder during the scarfing period and subsequently discharged through an irrigated electrostatic precipitator cleaning unit continuously at a more or less steady rate.

Cleaning units of this type are fitted on a number of existing scarfing machines in the U.K. and all new machines must be so equipped.

Problems Associated with Dust and Sludge Handling

Fume containment and gas cooling and conditioning are essential preliminaries to the actual cleaning operation and frequently present problems which are more difficult to solve. Another aspect of fundamental importance is what should be done with the fume when it has been collected, bearing in mind that a single large cleaning unit may collect ten to twenty tons of fume and fine dust per day. It is most desirable that no works should rush into a decision on the type of cleaning plant to be used without a thorough appraisal of the situation regarding disposal of the collected product.

All the foregoings are related facets of a single operation—gas cleaning—and the necessity for considering them as such cannot be too strongly emphasized.

The iron content of the dust may be 50 or even 60 per cent. and in such cases it is desirable that it should be re-used as far as possible. At one plant in Austria, dust from the electrostatic precipitator associated with an LD converter is conveyed from the base of the cleaner into paper sacks and charged back into the LD vessel. Works in the U.K. are investigating various agglomeration techniques which will put the dust into a more suitable form for re-use, but a technique which is completely satisfactory, both economically and technically, is still awaited.

Wet cleaning methods may be attractive, particularly to integrated works having experience in blast furnace sludge handling techniques but, so far, some of the smaller non-integrated works have tended to be apprehensive in the face of increasingly stringent water pollution legislation.

Economics

Although this session is primarily a technical one, technology and economics can rarely be divorced in industrial matters, and a brief mention of economics would seem appropriate.

In order to meet what would now be regarded as modern practice, a new integrated works would install gas cleaning equipment to control emissions from materials handling stations, coking plant, iron ore dryers, sinter machines, blast furnaces, steelmaking furnaces, scarfing machines, slag processing and refractories preparation plants. The capital cost of gas containment, cooling and cleaning systems for such an integrated works would probably be in the region of £3 million, and depreciation, operating costs etc., would amount to several hundred thousand pounds a year. Expenditure on this scale can be justified only where the technological principles and practice to be employed have been proved reasonably sound, and the period of time since 1958 has been used as a development and proving period; the benefits are already becoming apparent in many steelmaking areas.

MITIGATION OF AIR POLLUTION AT COKING PLANTS

by R. L. Cooper and J. P. Graham***

ANY consideration of the mitigation of air pollution at coking plants must take account of a number of factors, in particular the practical limitations imposed by the process of carbonization in coke ovens. The design and cost of equipment devised to reduce pollution are of major importance as is also the collection of accurate information and the definition of reasonable standards. Some of these aspects are examined in this paper.

The air pollution problem of the Coking Industry has long been recognised as both difficult and complex. Before considering the position with regard to any particular coking plant, however, and in order to keep the current situation in perspective, it should be remembered that at the present time there are only 54 coking plants in operation in Great Britain, that is, one to about every thousand square miles. For various reasons many plants have been closed in recent years and since 1956, the year of the Clean Air Act, the number has dropped from 83 to 54. The closure of these plants, which were among the older units in the industry, has in itself been a contributory factor in the reduction of atmospheric pollution, quite apart from the rise in the general level of efficiency and improvement of plant conditions in the larger modernized works which now make up the industry. It should follow that as the coke-making capacity of this country is gradually concentrated in these modern plants, improved facilities and designs will in turn help to mitigate atmospheric pollution, at the same time producing sufficient quantities of solid smokeless fuel (see Fig. 1). In all these circumstances, and particularly in view of the recession through which the Coking Industry is now passing, the interest which has been shown in measures for the mitigation of atmospheric pollution may be claimed to be commendable.

Charging of ovens

In a previous paper[1] read before this Society a brief account was given of the problems of the Coking Industry in respect of clean air. It was then indicated that the coke-oven battery itself was the chief source of pollution. There are serious practical difficulties associated with the charging of nearly 20 tons of finely-crushed coal from the hoppers of an oven larry-car into a hot empty oven with a wall-temperature of 1300°C.—all within the space of two or three minutes and with minimum emission of smoke to the atmosphere. Even with steam ejectors to assist suction and charging " on the main " it is very difficult to withdraw, into the gas-collecting main leading from the battery, the whole of the gas and smoke which is rapidly evolved when the coal descends into the oven. Many interacting factors are known to be concerned, including the properties of the coal-charge, the design of the equipment and the timing and sequence of charging operations. In the earlier paper[1] reference was made to the formation of a Joint Working Group of the Alkali Inspectorate and the British Coking Industry Association, the membership of which was drawn from both organizations and to which the staff of the British Coke Research Association were co-opted. The remit to this group was to examine the problem of smoke emission during the charging of coke ovens and to assess the relative merits of single and double

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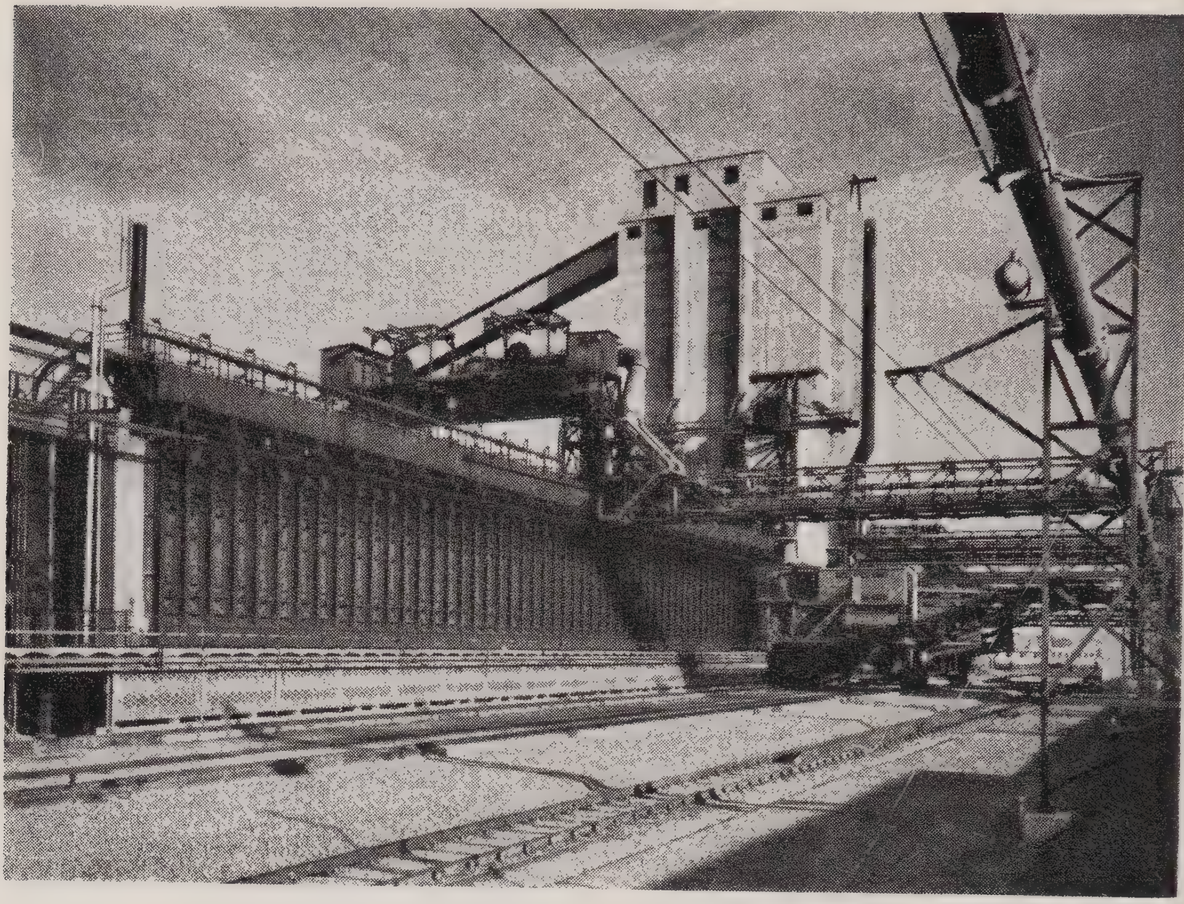

Fig. 1. General view of coking plant battery

collecting-mains.

In addition to inviting the submission of opinions and factual information from the Industry, the group carried out some 4,000 observations on 200 charging operations at five different coking plants providing six basic variations of oven-top equipment. A number of useful conclusions were drawn but it was recognized that there was much scope for further investigation. It was therefore recommended that additional work on the subject should be included in the programme of the Research Association. A detailed account of the Group has been given by Sellars and Hornsby-Smith.[2]

In collaboration with the British Coking Industry Association the British Coke Research Association has been asked to examine the factors which give rise to the emission of smoke during charging. The conclusions of the Group have been considered in some detail by a Technical Panel of the Research Association which studies practical plant problems. To give general guidance to the Industry in the light of present knowledge and in response to a request from the Chief Alkali Inspector the Association has recently prepared and circulated a special publication giving practical suggestions for the reduction of the emission of smoke, dust and grit at coke ovens.[3] These suggestions recognize the differences which occur between plants but should be applicable with suitable modifications to individual cases. The benefit gained from recent experiences with new devices or remedial procedures tested out along the lines suggested has thus been made generally available.

Theoretically, the basic solution to the problem is to adjust the rate of charging in accordance with the suction available, thus requiring a measure of control over both factors. Control of charging may be effected by employing positive feeding devices, but most plants practise simple gravity-feeding of the charge. In such cases the flow of coal may be aided by specially-designed hoppers with steep sides and smooth

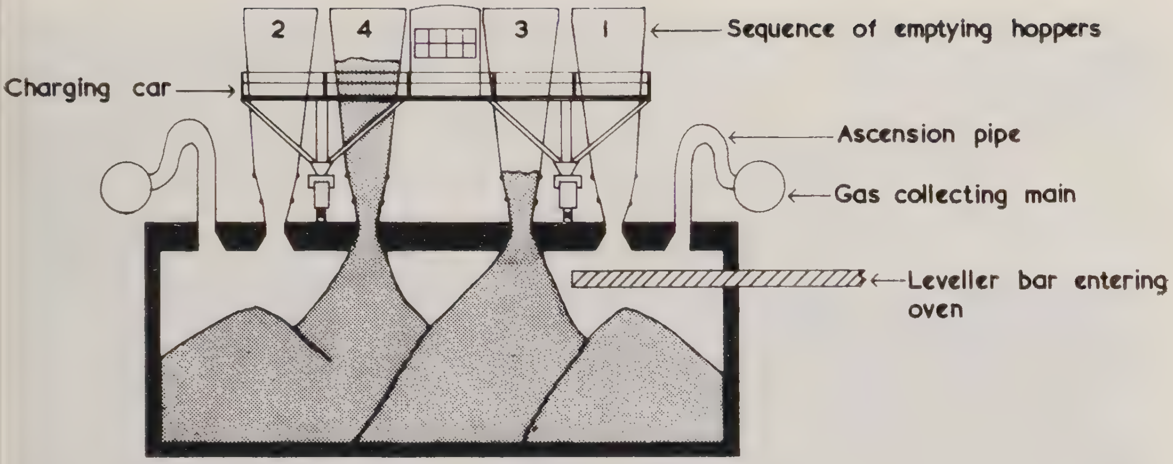

DIAGRAM OF A COKE OVEN BEING CHARGED SHOWING HOW THE GAS SPACE BECOMES BLOCKED

Fig. 2

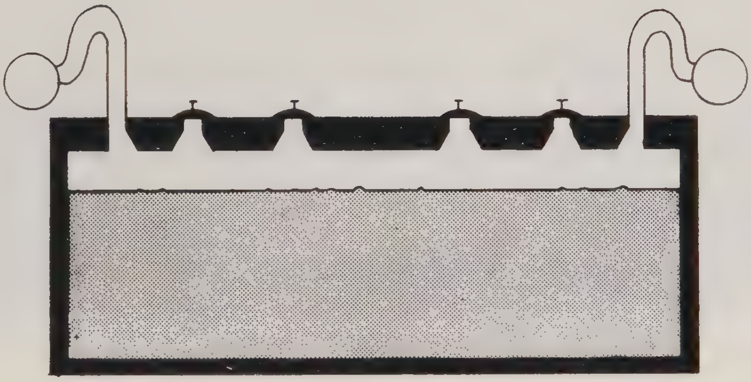

DIAGRAM OF A COKE OVEN AFTER LEVELLING SHOWING THE FREE GAS SPACE ALONG THE TOP OF THE CHARGE

Fig. 3

linings and by the use of vibrators. The size-grading, moisture content and the presence of additives such as oil may also affect the flow of coal. The method and rate of charging should be adjusted to avoid, so far as is possible, the blocking of the free space above the coal charge which leads to the gas off-takes in the collecting mains (see Figs. 2 and 3). Meades and Randall[4] have described a charging car (see Fig. 4) in which the capacity of the individual hoppers has been modified to facilitate sequential charging which allows each hopper in turn to be completely emptied and the charge-hole lids to be replaced quickly. Normal practice, in the past, has been for all hoppers to be discharged simultaneously. Swift removal of the gas into the collecting-main depends on the suction available and the working capacity of the mains. Investigations in the Industry have suggested a number of less expensive alternatives for providing suction at both ends of the oven in cases where double collecting-mains are not fitted. The alternatives usually require an additional hole in the oven top at the end opposite to the single collecting-main. One acceptable alternative consists of a breeches pipe, like an inverted " U " in shape, which can be mounted on a monorail or wheeled carriage for transport along the battery (see Fig. 5). As illustrated, it is arranged to connect the oven about to be charged to an adjacent oven already partly carbonized, so that the excess gases may be diverted from the former to the latter, the steam ejectors on both ovens being used to draw the gases into the collecting main. Another variation of this principle has been described[4] in which a pipe is mounted at the base of

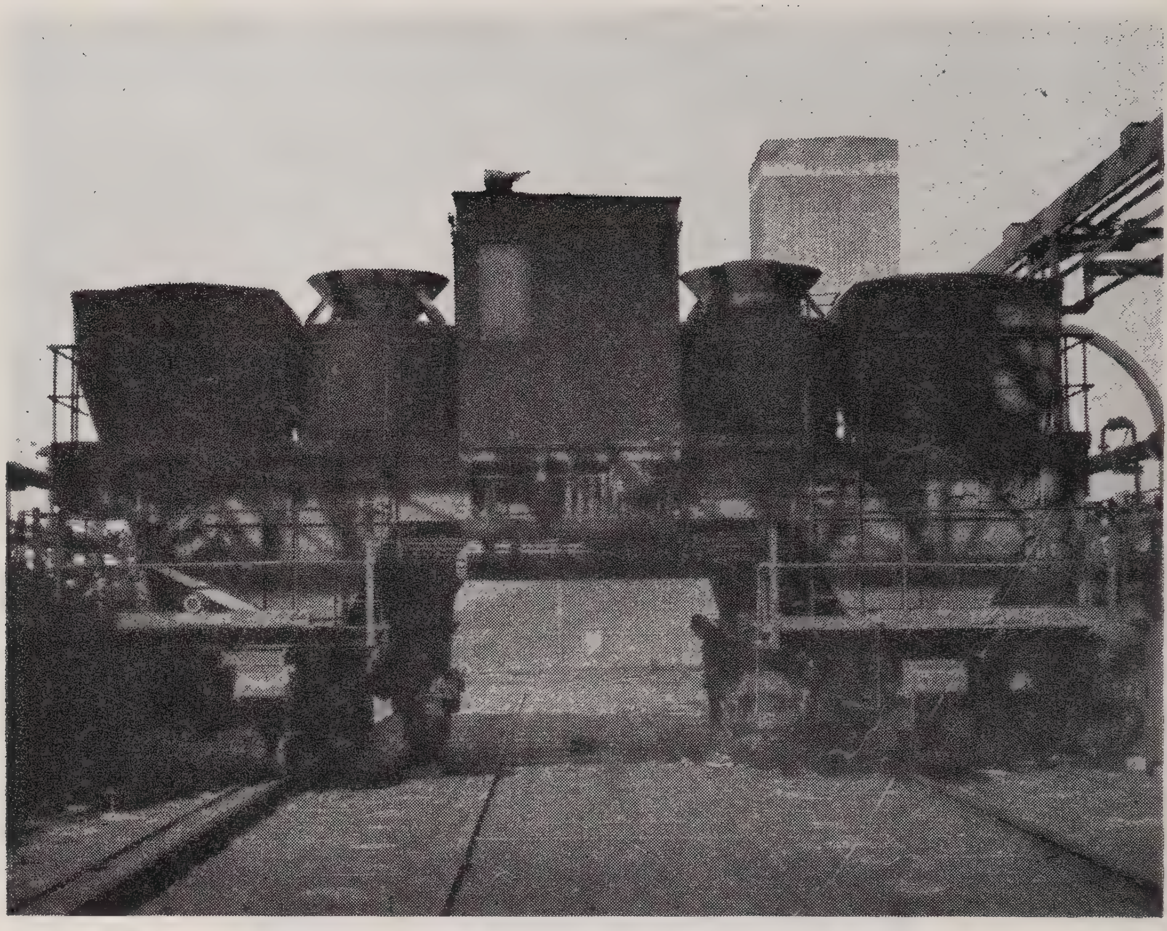

Fig. 4. Charging car specially designed for sequential charging

one of the outside hoppers on the charging car and connects it to a normal charge-hole in an adjacent oven. This obviates the need for additional holes and can readily be mechanized. A third method which has been used is a transportable chimney placed over the additional hole through which the gas escapes and is burned as it passes to atmosphere, resulting in negligible smoke. This device appears to require further investigation in order to ensure satisfactory ignition of the gas in industrial operation.

Good maintenance of the ascension-pipe necks and steam jets, together with quick replacement of charge-hole lids where the design of the charging car permits, all help to ensure that the best use is made of the available suction. During levelling of the coal charge some loss of suction may take place through the leveller-door opening just above the main oven-door on the ram side of the battery. It has been suggested that a smoke muff could be used to restrict this opening during the levelling operation.

The Chief Alkali Inspector has emphasized that the installation of equipment for smoke-reduction is not sufficient in itself, but that such equipment must be operated efficiently. This focuses attention on two important points—operating conditions and the need for measurement of the effectiveness of equipment. Poor conditions on the oven-top, possibly involving excessive heat and laborious duties, lead to inefficiency. In this respect double collecting-mains may have certain disadvantages since they create additional work and also increase the ambient temperature on the oven-top. On one occasion it was noted that this was more than 40°F. higher than the atmospheric temperature. To reduce the labour mechanical aids are being introduced, as described by Meades and Randall,[4] including an automatic lid-lifting device and a flail-cleaner for ascension-pipe necks.

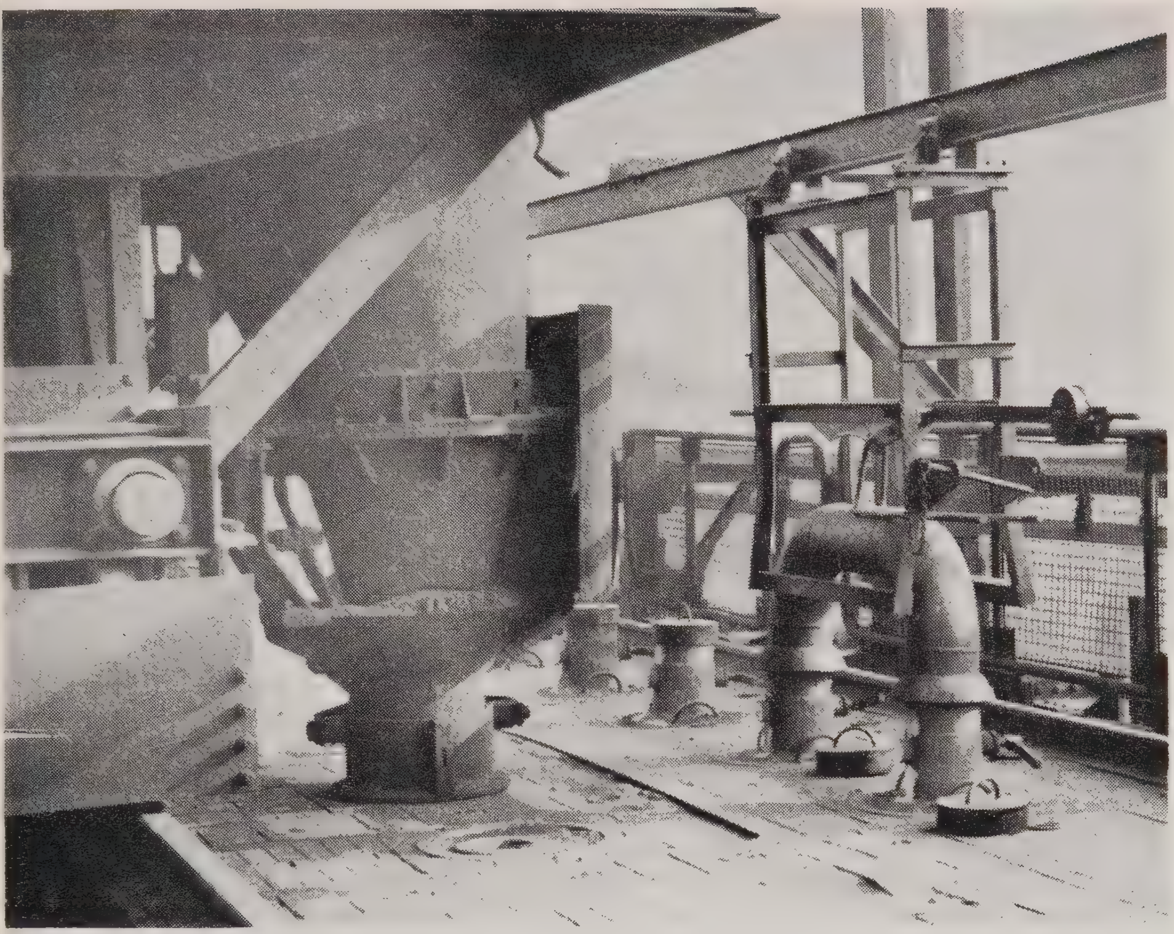

Fig. 5. Breeches pipe (**r**) *in position for charging*

Measurement of smoke

Some reliable measure of the amount of smoke emitted is needed and this underlines the need for a standard method of smoke assessment to ensure that an acceptable degree of smokelessness is being maintained, wherever the plant is situated. To meet this requirement the British Coke Research Association has instituted training courses in smoke assessment for coke-oven staff and operatives, using the method of measurement originally employed by the Joint Working Group in their investigations. The Association's course runs for five days and includes practical training on the oven-top, together with lectures and films to give a wide background to the subject. The response to these courses from the Industry has been very encouraging and to date more than 50 coke-oven personnel have been trained. In due course a conference will be held at the Coke Research Centre at which all those who have been trained in the method will have an opportunity of discussing their experiences in relation to smoke prevention at their own works, thus contributing to the general knowledge on the subject. To ensure that regular and reliable smoke-measurements are being carried out the staff of the Research Association, using the new mobile laboratory, will visit plants to give advice and standardize measurements.

The method of smoke-measurement employs work-study principles in conjunction with subjective visual estimations. By computing the sum of the products of the duration of emission for each of five empirical density-levels and the relative density, a "mass emission factor " is evaluated which is a measure of the total amount of smoke emitted. Included in the Association's Programme of Research is a project for refining methods of smoke assessment.

Other sources of smoke from battery operations are also under examination.

These include general attention to detail such as cleanliness on the oven-tops and the smoke emitted from the edges of oven-doors and from chimneys. The discharge of coke from the ovens is a further source of smoke and grit which is to be considered (see Fig. 6). Uniform carbonization of the charge by means of efficient heating of the battery is an important factor.

Quenching of coke

The practice whereby the red-hot coke discharged from the ovens is cooled by water-sprays in a quenching-tower is a source of grit emission. A number of grit-arresting devices fitted inside the tower have been tried and briefly reported.[1] The method which has attracted the most general attention is that also used in the full-scale test plant at the Coke Research Centre. The quenching-tower has wooden grids fitted several feet below the top and arranged so as to produce changes in the direction of flow of the rising steam, thus deflecting entrained particles of grit back into the tower (see Fig. 7). Some 12 coking plants are now fitted with grit arrestors and it can be fairly said that the Industry is actively responding to suggested methods for pollution prevention once those methods have been attested as practicable.

Further research

In addition to the practical measures described above and conducted in conjunction with the Industry, the British Coke Research Association has included in its programme investigations into the identification of sources of air pollution from coking plants. Methods for identifying individual particles of dust and grit are under examination, including microscopic and chemical techniques. One purpose is to determine the sources of emission and to assess the degree of improvement

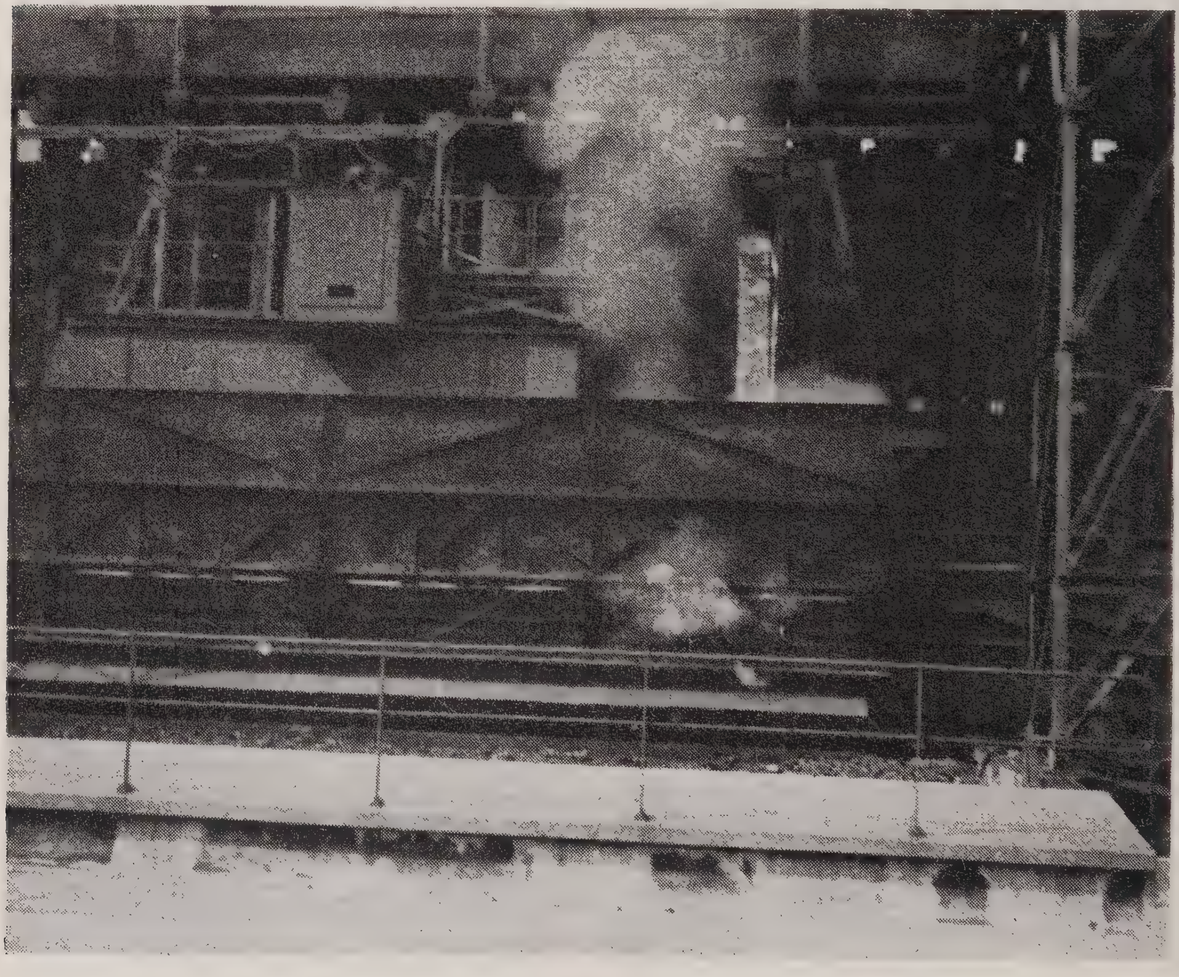

Fig. 6. Coke being discharged from oven into coke car

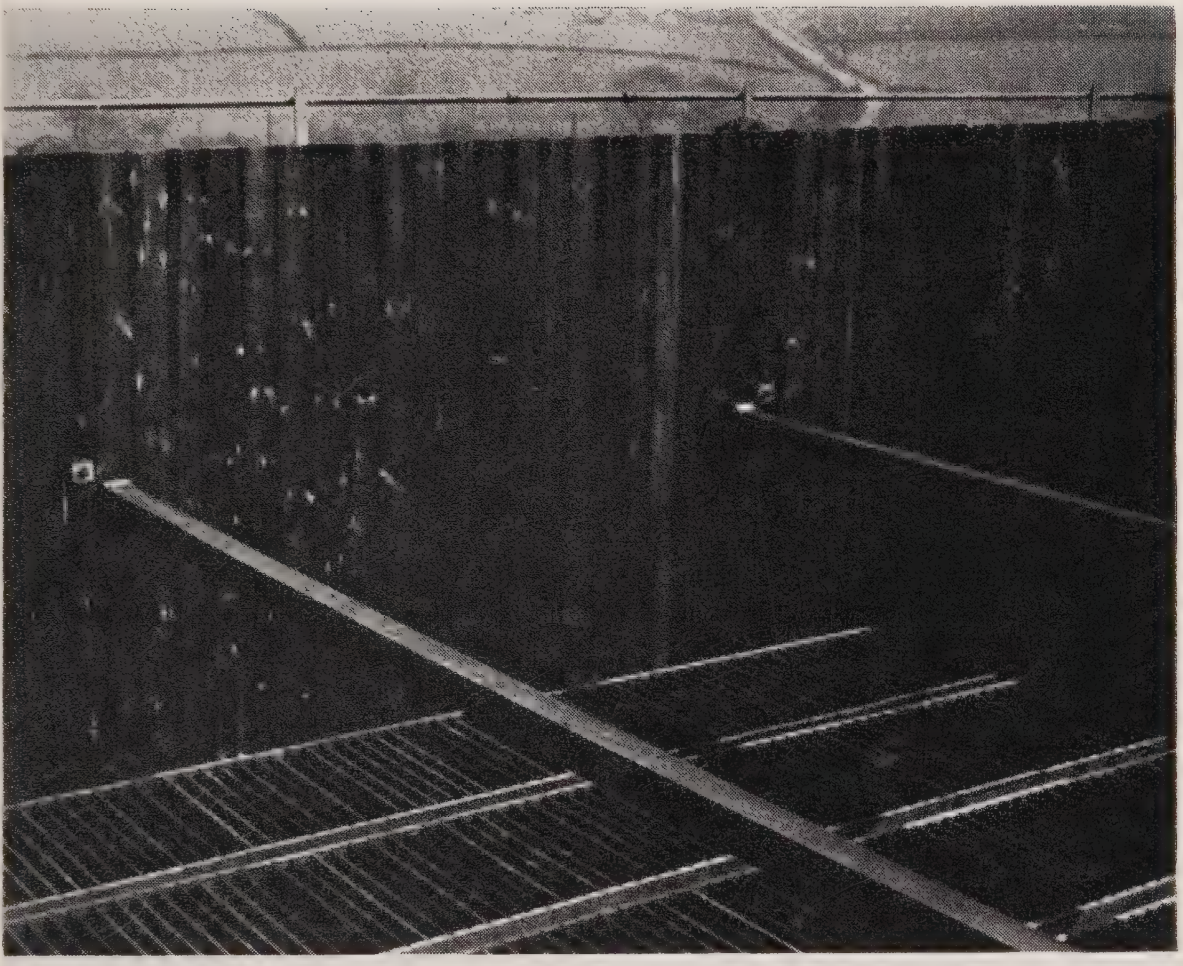

Fig. 7. Grids fitted near top of quenching-tower at the B.C.R.A. test plant

effected by remedial measures or the need for further improvement. Another objective is to differentiate between the pollution arising from coking plants and that which originates from external sources. In addition to morphological studies, special microscopic techniques including the use of polarised light and measurements of refractive index are being examined. Sampling methods are also being investigated.

As was mentioned at the beginning of this paper, the air pollution problem of the Coking Industry is exceptionally difficult and complex to overcome. Nevertheless, progress is being made towards an amelioration of atmospheric pollution from coking plants and there is hope of further improvement in the future.

We are indebted to the Woodall-Duckham Construction Co., Ltd., Dorman Long (Steel) Ltd. and the National Coal Board, East Midlands Division, for some of the illustrations in the paper.

The authors wish to thank the British Coke Research Association for permission to present this paper.

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AIR POLLUTION FROM IRONFOUNDRY CUPOLAS

*by F. M. Shaw, A.M.I.Mech.E.**

IRONFOUNDING is one of the oldest basic industries and shows no sign of decreasing in importance. In 1961 the industry in the United Kingdom produced 3,805,900 tons of castings. Two of the largest consumers were the iron and steel industry, which took 636,700 tons (largely in the form of ingot moulds), and the automobile industry, which consumed 695,300 tons. In producing this tonnage, the ironfoundries burned 1,274,200 tons of fuel, 65 per cent. of which was foundry coke for melting, 14 per cent gas coke, and 21 per cent. coal, the latter two being mainly used for auxiliary operations. This may be compared with an annual usage of coal in the United Kingdom of just under 200,000,000 tons for all purposes. The average sulphur content of coal is about 2·5 per cent., as opposed to foundry coke, which contains under 1 per cent. sulphur. The number of employees in 1961 was 130,000.

The number and size of ironfoundries is changing, and Tables 1 and 2 (from statistics supplied by the Council of Ironfoundry Associations) show some interesting trends. The years 1955 and 1960 are comparable in the sense that in both years, general ironfoundry activity was at a high level.

TABLE 1

Year	*Number of Ironfoundries in U.K.*
1951	1929
1955	1799
1956	1706
1957	1673
1958	1583
1959	1518
1960	1485
1961	1435

TABLE 2

Ironfoundries classified according to tonnage of castings produced. (1955 statistics based on full year's figures; 1960 statistics based on annual rate for the second quarter.)

Annual Rate of Production tons per annum	*FOUNDRIES*				*PRODUCTION*			
	Number		*% of total*		'000 *tons*		*% of total*	
	1960	1955	1960	1955	1960	1955	1960	1955
Under 200	159	493	10·71	27·40	7·3	45·1	0·02	1·15
201–400 . . .	440	285	29·66	15·84	94·5	83·8	2·51	2·14
401–800 . .	309	336	20·78	18·68	205·2	191·0	5·10	4·86
801–1,200 . .	125	177	8·41	9·84	118·2	172·7	2·94	4·40
1,201–2,000	151	189	10·17	10·51	237·0	294·7	5·89	7·51
2,001–5,000	166	184	11·18	10·23	511·1	583·5	12·69	14·87
5,001–10,000	66	72	4·44	4·00	434·7	497·8	10·80	12·68
Over 10,000	69	63	4·65	3·50	2,417·1	2,056·5	60·05	52·39
Total . .	1485	1,799	100	100	4,025·1	3,925·1	100	100

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* The British Cast Iron Research Association.

From this, some general inferences can be made.

(*a*) The number of ironfoundries is decreasing (494 less in 1961 compared with 1951, even though the tonnage of castings made increased in that period).

(*b*) There is still a large number of small foundries. In 1960, 159 foundries produced under 200 tons per year, or 0·02 per cent. of the national output. This is an important factor to bear in mind when air pollution costs are considered, because of the disproportionate increase in production costs for small foundries.

(*c*) It is largely the very small foundries that are going out of existence. There was a decrease from 493 to 159 foundries producing under 200 tons per year between the years 1955 and 1960. So far as air pollution is concerned, this is an advantage because it is the very small production units which find it difficult to spend money on dust collection.

(*d*) The number of very large foundries is increasing (foundries producing over 10,000 tons per year increased from 63 to 69 between 1955 and 1960).

The main source of air pollution from ironfoundries is from cupolas. The maximum number of cold blast cupolas running at one time is likely to be about 1,000 and their range of melting rate is from 1 ton to 30 tons per hour. In addition, there are about 50 cupolas using hot blast (that is, the combustion air is pre-heated) ranging in size from 2 tons per hour to 30 tons per hour. Of these, about 70 per cent. use the heat in the stack gases to heat the blast and the remainder have separate oil or (rarely) gas fired blast heaters. Cupolas melt over 90 per cent. of the metal used by the industry. The bulk of the remainder is blackheart malleable iron melted in coal or oil fired air or rotary furnaces. Electric furnaces are used for some special irons (for example, nodular iron).

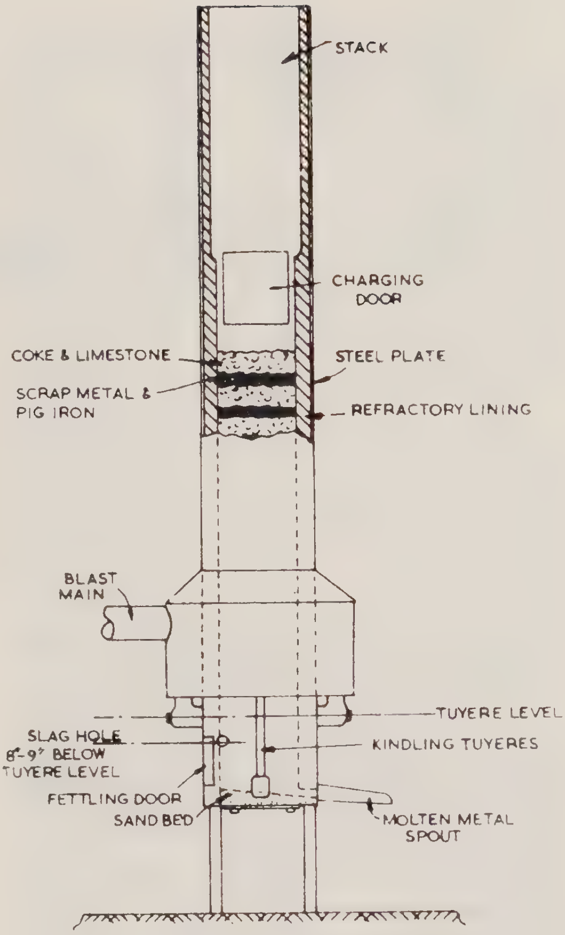

Fig. 1

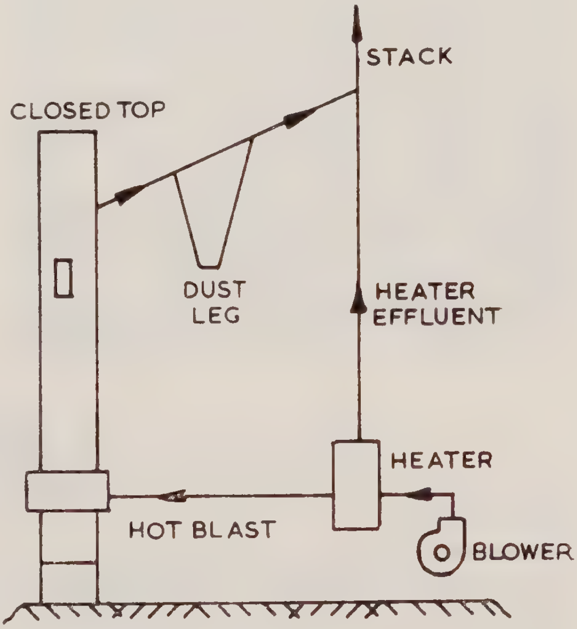

Fig. 2

Figure 1 shows a typical cold blast cupola. *Figures* 2 *and* 3 show typical layouts for separate blast heater and recuperative types of hot blast cupola.

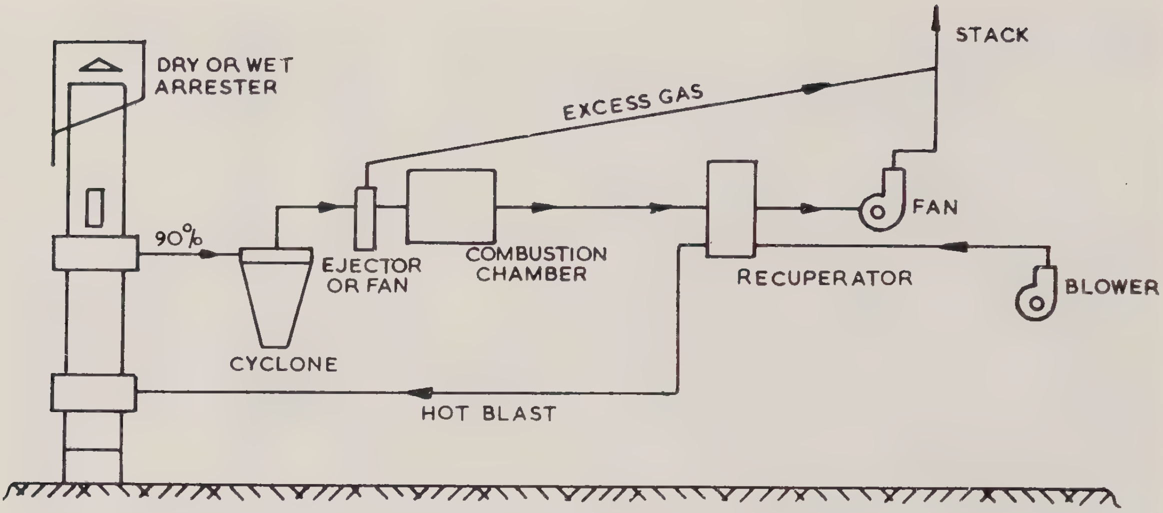

Fig. 3

The cupola itself is basically the same whether or not hot blast is used.

The air pollution problem varies in degree with the type of cupola used. Table 3 gives some idea qualitatively of the problems associated with the different types.

There is, however, some overlapping, and the above should be taken as a guide only.

Many of the smaller foundries melt for 2 to 3 hours, two or three times a week, that is, between 200 and 450 hours per year, and there are the smallest foundries which may only melt once per week. Mechanized foundries usually melt for 8 hours every day (2,000 hours per year). Some of the very largest foundries operate two shifts and thus melt for 4,000 hours per year.

Cold blast cupolas come under the jurisdiction of the Local Authority, but hot blast cupolas have been scheduled under the Alkali Act. The two types of cupola will therefore be treated separately.

Cold Blast Cupolas

There are no standards of emission to which cold blast cupolas must conform. It would, in fact, be very difficult to set and enforce any because of the difficulty in making accurate emission tests on the usual cupola. However, at a meeting in 1958* between members of the Association of Municipal Corporations and the Council of Ironfoundry Associations, the industry did agree that the wet type of grit arrester was " reasonably practicable " for cupolas working at least 1,000 hours per year, but that for cupolas running for under 250 hours

TABLE 3

Potential pollution

	Grit and dust	*Metallurgical Fume*	*Smoke*	*Sulphur*
Cold blast cupola ..	Yes	Small	Some	Very small
Hot blast cupola—recuperative ..	Small	Yes	Some	Very small
Hot blast cupola—blast heater ..	Yes	Yes	Some	Very small

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* Supplement to Municipal Review, January 1959

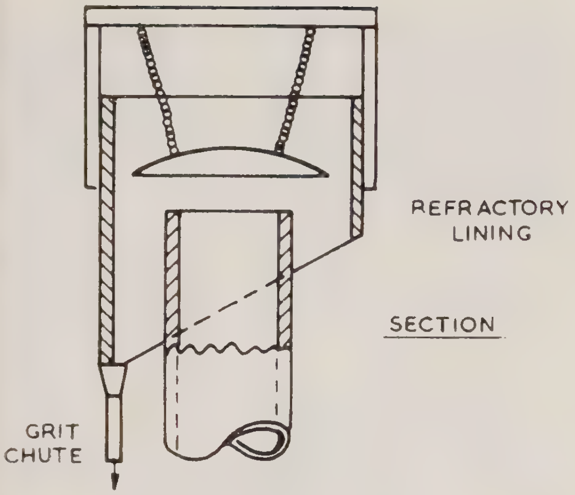

Fig. 4
Typical simple dry arrester

per year it was considered that simple dry type arresters should be adequate.

A high proportion of the solid emission is large in size and since it is the large particles which cause deposition complaints, it is possible to achieve good results by relatively simple means.

(1) *Simple dry arrester* (*see Figure* 4)

This type of arrester is cheap and has no power costs, maintenance being limited in most cases to periodical replacement of the baffle. This may be required every few weeks in some cases, and in these circumstances, a hollow water-cooled cone should be used. The main principle used to clean the gases is to alter the direction of gas flow and cause heavy particles to hit the sides and run down to the bottom tnto a collection chute. Expansion of the gases (up to four times) is also utilized to slow down gases and effect some collection by gravitation.

It must be admitted that these collectors can only remove large particles from the gas stream; few particles under 200 microns are likely to be arrested. Nevertheless, it is suggested that for most small, infrequently used cupolas, they are sufficient to prevent complaints and are indeed all that can be justified economically.

Approximate costs in terms of the extra burden put on each ton of metal melted are given in Table 4(1).

It will be seen that in the not infrequent case of a 2 tons per hour cupola used twice per week for 2½ hours (250 hours per year) a simple dry arrester will increase metal costs by about 3s. 6d. per ton. If the same cupola was used for only 50 hours per year, the extra cost would be about 14s. 0d. per ton. The effect on the cost of invoiced castings will be 1½ to 2 or more times the figures quoted, depending on the yield (that is, weight of castings produced per unit weight of metal poured) and the proportion of rejects.

A common variant of the dry arrester illustrated is the air cooled type (*Figure* 5). The admission of cold air at the arrester bottom reduces the necessity for a refractory lining; it does not, however, increase the dust collection efficiency. The use of a cold stack also reduces the ease with which complete combustion of the stack gases can be obtained (see later under " Smoke ").

TABLE 4

Cost of simple dry arresters in terms of £/ton of metal melted

Melting rate, tons/hour	*Cost, £/ton metal melted for various yearly running times*						
	2,000 h	1,500 h	1,000 h	500 h	250 h	100 h	50 h
2	0·05	0·07	0·07	0·13	0·18	0·45	0·70
3½	0·04	0·05	0·05	0·10	0·13	0·34	0·53
6	0·03	0·04	0·04	0·08	0·11	0·28	0·44
8	0·03	0·04	0·04	0·08	0·11	0·28	0·43
12	0·03	0·04	0·03	0·07	0·09	0·23	0·35

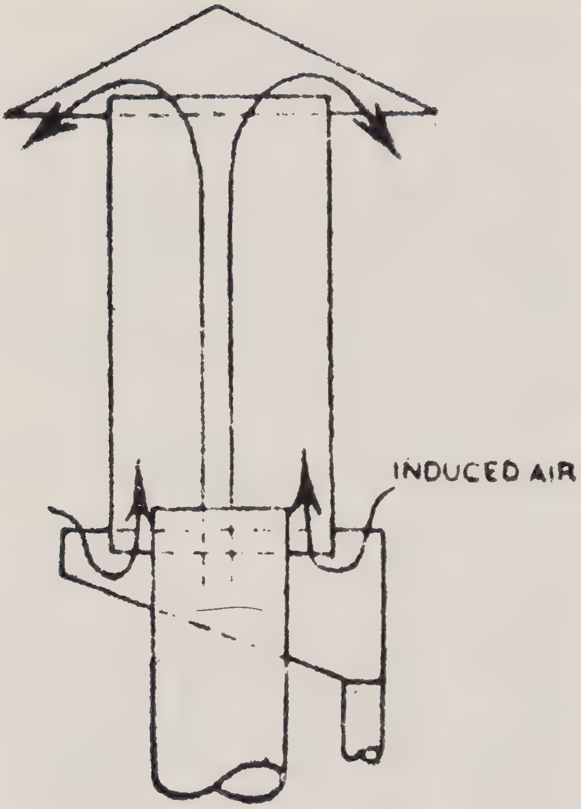

Fig. 5
Air cooled dry arrester

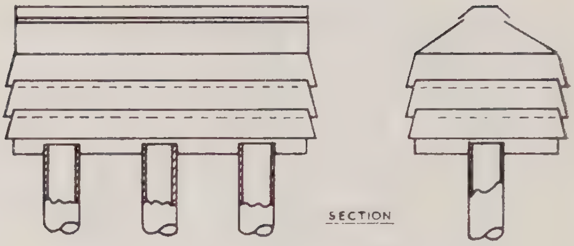

Fig. 6
Typical cupola penthouse

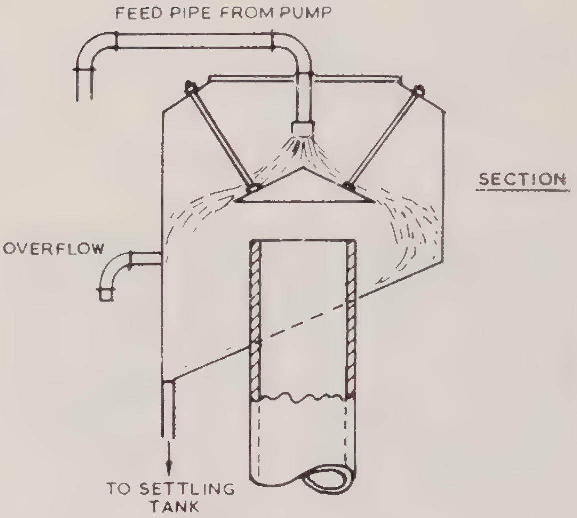

Fig. 7
Typical wet arrester
(*Tank and pump not shown*)

More elaborate versions have been made providing more changes of direction and increased expansion. As the size and elaboration increases, so does the cost and efficiency until the stage is reached when a penthouse is used.

(2) *Penthouse* (*see Figure* 6)

If a cupola stack discharges into a large louvred structure, high expansion ratios can be achieved (defined as

$$\frac{\text{Floor area of penthouse}}{\text{Area of cupola stack outlet}}).$$

Ratios of 50 to 100 are common. This results in deposition of most particles over 150 microns. While well-designed penthouses appear to collect sufficient grit and dust to remove deposition complaints in the neighbourhood they are expensive and have the disadvantage that their bulk produces down-draught eddies on the lee side which can bring the cupola gases and residual dust and fume down to ground level very quickly before natural dispersal and dilution has had time to make them less noticeable.

The big advantage a penthouse possesses is that running costs are very low. Only periodical cleaning out (say, monthly) and occasional replacement of sheets, say, every 10 years, is required.

The running and maintenance costs of the penthouse arrester are low, but the more efficient wet arrester is cheaper to buy though it does admittedly have significant running costs.

(3) *Wet arrester* (*see Figure* 7)

The biggest development in recent years in the ironfounding industry's fight against air pollution has been the fitting of wet arresters on cupolas. The number of installations must now run well into three figures. Provided this type of arrester is correctly designed and operated, complaints caused by grit and dust can be eliminated.

Basically, a wet arrester is the same

as its dry counterpart except that the refractory lining is removed and a water spray is fitted over the cone to cover the space between the cone and shell with a continuous curtain of spray. The power to drive the gases through the arrester is derived from stack draught and since this is limited, the arrester must be designed to reduce back pressure to a minimum. In practice it has been found that the stack draught derived from an approximately 20 ft. stack with a diameter of not less than the lined cupola shaft diameter will drive the gases through an arrester having a gas path area not less than 2½ times that of the stack.

The water flow is not critical, but should not be less (and preferably 50 per cent. greater) than that given by the formula:

$$\text{Water flow, gallons/minute} = 0{\cdot}02 \times \text{maximum cupola blower capacity in cubic feet per minute.}$$

This will ensure that the shell is kept sufficiently cool even during blow down when the gas temperature can reach 1,200°C. The water spray itself does not seem to need to be very fine to achieve its maximum collection rate. This is possibly because the major purpose of the spray is to wet the arrester walls so that any particles striking the walls are captured. Dust removal by passing the gases through a spray may be a relatively minor collection mechanism. Many of the earlier plants made the natural mistake of using unnecessarily fine sprays. The main result of this was to produce fine droplets which were entrained in the rising gases and blown out of the cupola, covering the surrounding area with fine rain. If, as is usual, the water is neutralized with soda ash, the " rain " becomes more unpleasant and harmful to paintwork. The simple answer to this is to size the spray nozzle and pump so that the water velocity does not exceed 700 feet per minute.

Corrosion is caused by the pick-up of sulphur oxides in the usually recirculated water. This quickly leads to the water becoming a weak solution of sulphurous and sulphuric acids. As may be imagined, the effect on mild steel is little short of disastrous. In every case where water is recirculated, therefore, it is essential to neutralize the water. Soda ash has proved excellent for this (about half a pound per one hundred pounds of coke burned is required, costing roughly three pence per ton of metal melted).

The effect on metal costs of installing wet arresters is given in Table 5(1). Where cupolas are small and infrequently used, the cost becomes prohibitive. For example, for a 2 tons per hour cupola used 100 hours per year, the increase in metal cost is about 25s. 0d. per ton. However, for cupolas used 1,000 hours per year or more, the cost is not unreasonable, for example for a 3½ tons per hour cupola used 1,000 hours per year the increase in metal cost is approximately 3s. per ton.

TABLE 5

Cost of wet arresters in terms of £/ton of metal melted

Melting Rate, tons/hour	*Cost, £/ton metal melted for various yearly running times*						
	2,000 h	1,500 h	1,000 h	500 h	250 h	100 h	50 h
2	0·11	0·13	0·17	0·30	0·55	1·25	2·35
3½	0·10	0·12	0·15	0·26	0·47	1·03	1·97
6	0·09	0·11	0·13	0·23	0·42	0·90	1·67
8	0·09	0·10	0·12	0·22	0·39	0·81	1·52
12	0·08	0·09	0·12	0·20	0·35	0·72	1·33

The collecting efficiency of a wet arrester, like that of any other type of collector, depends on the dust presented to it—the coarser the dust the more of it that is collected. Cupola dust is variable in both size and quantity, but generally speaking, about 50 to 60 per cent. of the grit and dust is likely to be collected. Analyses of collected dust indicate that virtually all particles down to grit size (76 microns) are removed from the gases and a substantial proportion of dust smaller than this. No cases are known to the author of complaints of cupola grit and dust deposition continuing after wet arresters have been installed and this must be the acid test for any piece of air pollution control equipment.

It must not, however, be expected that a wet arrester will have any visible effect on fume and smoke. These are composed of such fine particles that they pass straight through anything but the most efficient and expensive types of collector (electrostatic precipitator or equivalent). A number of wet arresters have been asked for in the vain hope that the water spray would remove smoke and this has led to disappointment. It is nevertheless the author's opinion that the most effective collector that is economically practicable for most cupolas is a well-designed and maintained wet arrester. Significantly less efficient collectors can lead to deposition complaints and anything efficient enough to collect fume as well is likely to cost ten times as much or more. The problem of smoke is not one of collection and is dealt with separately.

(4) *Collectors of very high efficiency*

Nowhere in this country or in Europe has a collector more efficient than the conventional wet type been fitted to cold blast cupolas. In the U.S.A. a few multicyclone type collectors have been installed and in the particular area of Los Angeles, fabric filters and electrostatic precipitators are used generally for all cupolas. It is only the geographic isolation of Los Angeles from other iron casting producing areas that has made it economic to spend very large sums on cupola gas cleaning.

Insistence on such expensive collectors had also led to the substitution of other types of furnace in specific cases. But it should be noted that this can never be a general answer to cupola emission, since the cupola has operational and metallurgical advantages which are essential for the economic production of most types of cast iron. However, even in the United Kingdom, electric furnaces are used for highly alloyed cast irons and their use is increasing for nodular iron manufacture. All this only contributes a few per cent. of the total weight of iron castings produced.

Multicyclones used on a few American cupolas are somewhat more efficient than wet arresters in removing dust from the gases, but nevertheless they do not remove metallurgical fume and smoke, so that the visibility of the emission remains unaltered. Capital costs are not available but are likely to be five times as much as wet arresters. Running costs will be much higher because a large induced draught fan is required.

Fabric filters are capable of producing an invisible effluent Synthetic or glass fibres are used and apart from cost there are no major technical problems. Some idea of the capital cost can be gained from some French figures for a glass fibre filter installed on a hot blast cupola installation. The cupola melts up to 16 tons per hour and the capital cost of the filter installation is roughly £100,000.

The degree of cleaning effected by electrostatic precipitation depends on the design, whereas a fabric filter always has an efficiency of near 100 per cent. unless there are holes in the filter material. The effluent from electrostatic precipitators is usually visible, though far lighter than the original fume. To clean the gases down to 0·05 grains per standard cubic foot (near the limit of visibility) is likely to cost £5 per installed standard cubic foot per minute. While this may seem very high compared with the frequently quoted figure of £1 per cubic foot per minute for electrostatic precipitators, it should be noted that the latter figure is for the precipitator unit only. By the time ducting, conditioners, dust diposal, instrumentation, foundations, steelwork, etc., have been added, the cost can be £5 per standard cubic foot per minute. In the Los Angeles area far more fabric filters have been installed than electrostatic precipitators.

Hot Blast Cupolas

Ironfoundries until recently did not use any processes which were scheduled under the Alkali etc. Works Regulation Act, 1906. Section 17(3) of the Clean Air Act allows the Minister to extend the list of processes scheduled under the Alkali Act.

A public enquiry was held in 1957. In order to reach some degree of uniformity over the whole country, the industry (through the Council of Ironfoundry Associations) asked that all melting processes should be scheduled. One outcome of the enquiry was that the Alkali Inspectorate took over responsibility for hot blast cupolas, leaving cold blast cupolas under the jurisdiction of the Local Authorities.

The effluent from hot blast cupolas is more of a problem than that from the general run of cold blast cupolas, because of the greater amount of metallurgical fume generated. This has the appearance of light coloured smoke, but does not consist of combustible matter. Its particle size is small (largely under one micron) and an electrostatic precipitator or equivalent would be required to remove it from the stack gases. The major factors influencing the quantity of metallurgical fume made are the blast temperature (normally 400°C. to 500°C.) and the proportion of steel in the charge. Neither can be reduced significantly without so reducing the economic advantages of using hot blast that the process becomes pointless. No means of preventing the generation of fume are known and it seems that it will have to be accepted and dealt with after formation.

The industry has accepted that a degree of grit and dust collection, followed by a stack to disperse the fume, is necessary. These principles are embodied in an agreed statement of provisional " best practicable means ". This statement was a result of negotiations between the industry and the Alkali Inspectorate and has been in operation since 1959.

The provisional agreement, which directly affects all new installations, is as follows:

1. The discharge of fume is to be dealt with by dispersion through chimneys of normal minimum height of 120 ft. For cupolas melting at a rate of 7 tons per hour or less, consideration will be given to the use of chimney heights down to a minimum of 80 ft., depending on site conditions.
2. For externally-fired hot blast cupolas above 7 tons per hour capacity and recuperative hot blast plants of all sizes:

   During the main operating period approximately 90 per cent. of the effluent gas will be extracted, passed through a powered cyclone and discharged into a chimney of suitable height.

   During the blow down period, as much of the furnace gas as practicable shall be passed through the cyclone/chimney system. In cases where it is not practicable to pass any part of the gas through the cyclone/chimney system, then it shall be permissible for the whole of the gas to be discharged through an arrester installed at the top of the cupola stack. During this period, dry or wet arresters are acceptable alternatives.
3. For externally-fired hot blast cupolas up to 7 tons per hour:

   The provision of a dust leg (that is, an expansion chamber operated by the stack draught only) and a chimney of a minimum height of 80 ft. taking 100 per cent. of the cupola gases during the blowdown period as well as the main operating period.

The agreement does not cover " outsize " hot blast cupolas (for example, a group of two or more 30 tons per hour furnaces) or the use of oxygen-enriched air. Existing plants will be treated on their merits, since in many cases alterations to meet the above agreement are impracticable.

In common with other industries, a Working Party has been set up, consisting of representatives of the industry and the Alkali Inspectorate, for the purpose of reviewing the steps being taken by the industry to solve its hot blast cupola air pollution problems. This working party has not yet finished its work so that it is too early to say what means of gas cleaning or dispersion may eventually be required for the different sizes and classes of hot blast cupolas, but installations complying with the provisional " best practicable means " are now coming into use and show promise of success.

Cupola Smoke

Smoke is caused by the incomplete combustion of oil, paint, grease, etc. present on the scrap metal charged into a cupola. The problem of smoke emission is common to both hot and cold blast cupolas though the answer to it may differ in detail. Smoke can be removed by combustion, since collection is difficult and expensive because of the small size, etc. of smoke particles.

To take the case of hot blast cupolas first, these are divided into recuperative, and oil- or gas-fired blast heater designs. In the case of recuperative plants, about half of the gases are burned in a combustion chamber and used in a recuperator to heat the cupola blast. Thus, half the smoke is removed. Hot blast cupolas have been designed in which it is possible to burn all the gases but such an arrangement adds considerably to the cost of the plant. There is usually no possibility of adapting existing hot blast plants so that all the effluent gas can be burned.

Where the blast is heated in a separately fired heater, all the stack gases pass direct to atmosphere without any use being made of their calorific value; this is the same as in cold blast practice. Thus, smoke elimination in this case poses the same problems as that from cold blast practice and will not be discussed separately.

It is possible to burn smoke in the cupola stack, if the correct conditions are maintained. These are:

(*a*) The gases are combustible. Gas composition is mainly affected by the proportion of coke in the charge. The higher the coke ratio the richer the gas. With low coke ratios of 8 to 9 per cent., the gas is low in carbon monoxide and is incombustible. From 9 to 10 per cent. coke in most cases produces a gas which is combustible with difficulty. 11 per cent. seems to be about the minimum coke ratio which can be expected to give a gas which burns with relative ease. Many cupolas run on lower coke ratios than this, so that smoke elimination would mean using extra coke and reducing the thermal efficiency. This is a complete reversal from the problem of boiler smoke where smoke elimination and a raised thermal efficiency go hand in hand.

Increasing the coke ratio also has other effects, which may be undesirable when melting certain irons; the metal temperature, carbon and sulphur contents increase while the melting rate decreases. Generally speaking, however, these effects are less important than the extra cost of coke involved. To take a particular example, if the coke ratio for a 5 tons per hour cupola is raised from 9 to 11·5 per cent., an extra ton of coke will be used per 8 hour day, costing about £12, or about £3,100 per year—a considerable burden if no benefit other than smoke reduction is obtained.

(*b*) The gases are above their ignition point. This varies with composition but is about 300°C.

to 400°C. for combustible mixtures. The gas temperature can be raised by charging the cupola to a lower height. Modifications to the cupola, coupled with a very tight control of the charging cycle, may be required. By so doing there is less stock in the cupola to absorb heat from the rising gases. Unfortunately this also means that the cupola becomes less efficient thermally.

(*c*) Sufficient combustion space exists in the cupola stack to burn the gases completely. About 20 ft. of stack above the charging door top is required for medium sized cupolas. Fortunately, about the same stack height is also required to provide the necessary stack draught for a wet arrester.

(*d*) Sufficient combustion air enters the charging door. This is normally available and calls for no added equipment.

Stack combustion cannot occur when the cupola is cold at the beginning of the melt and it normally takes 5 to 15 minutes to establish combustion. When a new charge is put on the flame is often extinguished for periods ranging from seconds to a minute.

The practice of lighting up a cupola with wood, coal, oily waste, etc., is dying, and with it the considerable smoke often emitted during this period. Oil or gas burners can do the job smokelessly, efficiently, and frequently at less cost. There is, therefore, little necessity for smoke to be emitted during lighting up.

Sulphur Emission

When it comes to the emission of gaseous sulphur compounds, cupolas are very mild offenders when compared with boilers burning an equivalent amount of coal, coke or residual oil. Cupola coke is necessarily low in sulphur (0·8 to 1·0 per cent.) because any increase in the metal sulphur content is undesirable. About half the fuel sulphur is absorbed by the metal,

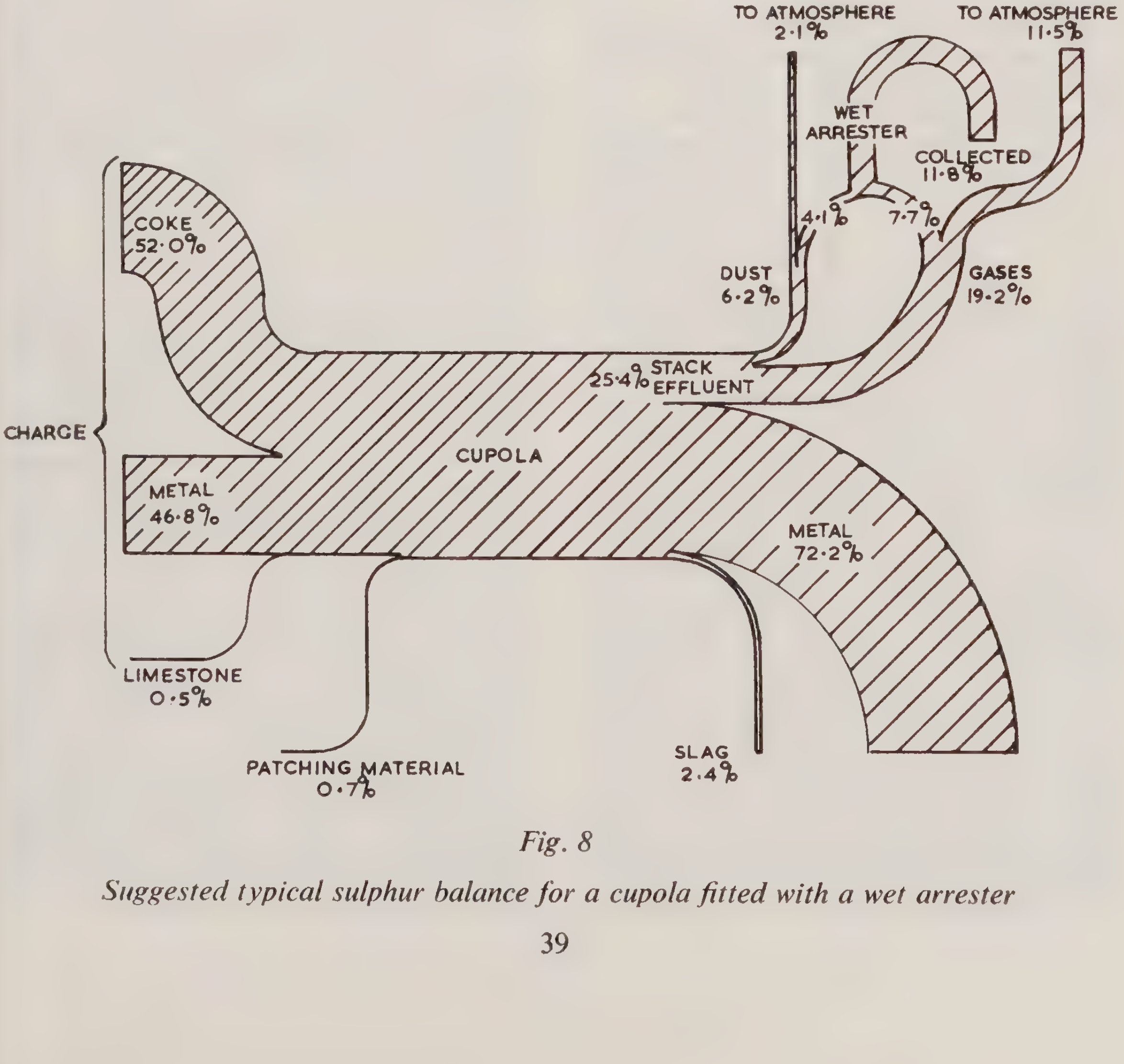

Fig. 8

Suggested typical sulphur balance for a cupola fitted with a wet arrester so that only half the already low sulphur content of the fuel enters the stack gases.

To take a typical example, a 5 tons per hour cupola with a 12 per cent. coke ratio burns 1,350 pounds of coke per hour and emits about 6 pounds of sulphur per hour. This may be compared with a typical 10,000 pounds per hour Lancashire boiler which, burning 1,350 pounds per hour of coal of 2·5 per cent. sulphur, would emit over 30 pounds of sulphur per hour. If any type of wet collector is fitted a considerable proportion of the already low gaseous sulphur is washed out of the stack gases. Tests indicate that even a wet arrester removes one-third to one-half of the gaseous sulphur. The removal of sulphur by the water can indeed be an embarrassment by leading to the formation of sulphurous and sulphuric acids which require careful and continuous neutralization to reduce corrosion to a minimum.

A suggested typical sulphur balance for a cupola is given in Figure 8[2].

Conclusions

1. Grit and dust emission from cold blast cupolas can be adequately dealt with by wet arresters.
2. Wet arresters are economically practicable for most medium sized cupolas but may be too expensive for small, infrequently used cupolas.
3. Smoke can often be consumed in the cupola by building and operating the cupola to achieve complete combustion of the stack gases.
4. Where low coke ratios are normally used, it may add considerably to the fuel consumption to ensure combustion.
5. Smoke generated during the lighting up period can be eliminated by the use of gas or oil burners to ignite the coke.
6. Metallurgical fume is generated primarily by hot blast cupolas where it is normally dealt with by dispersion from a tall stack.
7. Sulphur emissions by cupolas are low when compared with boilers of equivalent fuel burning capacity.

Acknowledgements

The author wishes to thank the Director and Council of The British Cast Iron Research Association for permission to present this paper.

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Discussion

R. A. Hacking in opening the Pre-Conference Technical Session, said "I would like first of all to refer to the late Dr. T. P. Colclough, whose close personal friendship, initiated by four years as working colleagues at Park Gate, I was privileged to enjoy for nearly forty years. From the outset, T.P.C. was dedicated to the cause, and whilst a Melting Shop Manager working enthusiastically for smoke abatement might have appeared something of an anomaly to most people in the mid-twenties, he was merely thinking ahead by a decade or two, as he did in so many other aspects of iron and steel technology. Over the years, his efforts, so far from being spared, were indeed intensified, and during the closing stages of his unique career, he must have derived great satisfaction from the arrival on the Statute Book of the Clean Air Act, and the subsequent rapid progress towards its implementation. Had he lived, I do not doubt that he would today be fulfilling in his own inimitable way, the function of Chairman of this Technical Session. Certainly he would have been immensely gratified by the excellent attendance, and the close interest thus demonstrated in the atmospheric pollution problems of his own industry, and the progress made towards their solution.

"The privilege of having the opportunity to carry on, however unworthily, where Tom Colclough left off, is to me a great personal honour, which I sincerely and humbly appreciate.

"As the Chief Alkali Inspector remarks in the paper we are to hear on Thursday morning, the iron and steel industry presented the most difficult of all the chemical engineering problems in connection with its emissions to atmosphere. In addition, iron and steel making and kindred processes came under the supervision of the Alkali Inspectorate at a time of extensive, and in some cases, almost revolutionary changes in production techniques. Hence, it seems appropriate that this pre-conference technical session should be devoted to consideration of some of the main problems in the iron, steel, carbonizing and foundry industries.

"We are fortunate in having three papers by authors intimately concerned with the full detail, and with vast experience in their respective fields. Time is rather limited, so without further ado I will call on Mr. A. H. Wood of the British Iron & Steel Federation to present his paper entitled 'Some Aspects of Air Pollution Control in the Steel Industry'."

P. H. G. Grimmett (Wednesfield), intimated that having a problem in his district respecting steel conversion, he, being very mindful of the economic factors connected therewith, asked if Mr. Wood could give an estimated cost of minimum requirements of sinter plant and of minimum dust required for economic operation of such equipment and whether such ferric oxide dust could be economically collected and transported to a sinter plant to effect if possible some return against the capital outlay involved in the acquisition of a grit arrestation plant.

Commenting upon the cautious observations of the speaker, Mr. Grimmett expressed the hope that the British Iron and Steel Federation Research Committee would not "ship their oars" at the present stage of progress but continue the good work already undertaken to remove such a problem as existed in his area and which now reared up as a sore thumb to be seen by all silhouetted against the sun, as a continuing and nagging argument against the extention of clean air in the district.

His authority was pushing on with smoke control areas and this facet was a continuing difficulty in this direction. Mr. Grimmett made reference to the fact that the Government were financially supporting through the Central Council of Health Education, the campaign against cigarette smoking with which he was in firm agreement, but he suggested that surely there was a parallel in that hazards of this kind were equally as dangerous to health. He suggested that a grant should be made available to allow the firms concerned to conform to the requirements of the Clean Air Act where an abnormally heavy cost upon their product could put them in jeopardy with regard to the marketing of same. Mr. Grimmett intimated that he enjoyed good relations with the firm in question and wished to explore every possible avenue of ameliorating the difficulty which affected the district as a whole.

B. D. Allen (Coventry), said that the information on training courses in the coking industry was very welcome and was a good step forward. However, progress to date, he said, left much to be desired as the fifty trained operators distributed amongst 54 plants, possibly working on a 24 hour basis, left many hours of operation without trained operators; much more must be done. He said that in relation to air pollution from iron and steel foundry cupolas, from the Table No. 2 given in Mr. Shaw's paper, 70 per cent of the foundries were producing less than 20 tons of castings per week, and 60 per cent were producing under 15 tons per week. This was obviously an industry of small concerns and thus the pollution problem was both serious and difficult to deal with. The fact that many of the very small foundries were going out of existence was an advantage as far as air pollution was concerned. He said that wet arresters were obviously the best solution, and sometimes low level fume emission due to a cool discharge gas was preferable to the dust and fumes emitted where either no arresters or dry arresters were fitted. He had noted that Mr. Shaw had not given any figures for the efficiency of dry arresters. With regard to fume discharge from cupolas he agreed that there was low sulphur content but unfortunately it was often discharged at a considerably low level, whereas the coal burning plant quoted would discharge at a high level, perhaps three times that of the cupola, and generally high dispersal presented no problem in smoke control areas. He appreciated that the iron and steel industry was tackling the problem of air pollution vigorously but these industries were continuing to cause severe pollution. With so much still to be done complacency must be kept at bay.

T. B. Chaffe (Dursley), described a problem at Dursley where a foundry was situated in the bottom of a valley and where a large Grammar School and houses were built on a level with the top of four cupolas and in close proximity to them.

There were two cold blast cupolas and two hot blast cupolas, the cold blast being fitted with wet type arresters and the hot blast with a powered cyclone and a chimney 120 feet high. The surrounding hills of the town forming the valley were described as some 400 to 500 feet above the valley floor.

Mr. Chaffe stated that he wished to deal solely with the cold blast cupolas because it was these which directly concerned his own Authority and from which a definite nuisance was being caused at the grammar school and adjoining houses during certain weeks of the year by the discharge of fumes and smoke. He asked Mr. Shaw if in addition to the wet type arresters already provided he could ask the firm concerned to do anything which was reasonably practicable to alleviate the nuisance.

Councillor C. A. Watson (Scunthorpe), said that insofar as the larger integrated steel works were concerned a genuine attempt was being made to minimise atmospheric pollution, especially in regard to the emission of grit and dust and, in regard to new processes, the dispersal of SO_2 by the erection of tall chimneys. Considerable thought was given to the problem and very large sums of money had been and were being spent by the industry.

But the results of those efforts could so largely be minimised by careless and thoughtless actions in the operation of these appliances.

In the ore preparation plant the operation of the reclaimers at the ore beds, particularly on dry and windy days, was a very heavy source of pollution, as was the work at the discharge end of the sinter strands.

Insofar as the operation of blast furnaces was concerned, whilst occasional and involuntary "slipping" could not at times be avoided in the Scunthorpe area, it seemed as though a part of the process was so to reduce blast, that a slip was caused resulting in heavy black mushroom clouds.

In the carbonization process at coke ovens, badly fitting doors and careless charging resulted in a continuous emission of dark smoke at almost ground level.

Factors like those constituted a good case for the creation of a post in works of that kind, filled by a responsible officer who should be responsible for the supervision and where necessary, the training of personnel who operated plant where careless or negligent work could result in pollution.

This was an established principle in regard to safety at work. Exhortation by itself had little result, both training and supervision were essential to the prevention of accidents.

Authors' Replies

A. H. Wood said he imagined the sort of problems Mr. Grimmett had in mind were those of a non integrated works having two or three small steelmaking converters. Assuming this were so, steel production may be say 5 tons per working hour, with emissions from the converters, including the heavy particles deposited in the steelmaking shop, of the order of 0·05–0·1 tons per working hour. A *small* sinter plant would deal with 20–25 tons of raw material per working hour, so that matching a conventional type sinter plant to the output of dust from a small steelmaking shop would be somewhat impracticable.

However, there may be two other courses open to some such works who find themselves in the position of having relatively small quantities of dust containing a high proportion of iron oxide and free from deleterious impurities. If there is a near-by works operating a sinter plant the dust might possibly be sold to them for say £2 10s. per ton delivered. Alternatively, pelletizing techniques are being developed, which could result in the dust from a dry collector being made suitable for use direct in the steel-making vessel itself. The value of the pellets may be around £4 per ton. It must be stressed that this applies only to dust which is free from contaminants; the only place for dust which is contaminated in the metallurgical sense is on the refuse tip.

The Air and River Pollution Committee of the B.I.S.F. is at the present time particularly concerned with questions of dust and sludge removal from the various oxygen steelmaking processes.

Replying to Councillor Watson, Mr. Wood indicated it was widely felt within the industry that relations with the appropriate air pollution control officers of local authorities and the Alkali Inspectorate should be made the responsibility of one man in each works, although such a man would not generally be responsible for training of personnel; this would quite legitimately be regarded as the responsibility of the manager of the department in which he was employed together with the works training department. It is of course most important that all men should be properly trained and made aware of the harm they can do by careless operation of plant which may result in air pollution.

Considerable difficulty had been experienced in keeping the discharge end of sinter plants clean. A dirty environment tended to result in skimped maintenance followed by breakdown of plant. Thus the urge for improvement of discharging conditions operated on all sides, and as a result of experience with existing plant the new units coming into operation were markedly better equipped for dust arrestment than were their predecessors.

In dealing with Councillor Watson's remarks on the practice of checking the blast in blast furnaces, it should be emphasized that this was done to prevent, or at least reduce, the incidence of "slips" which cause the gas bleeders to open and discharge dirty gas to the atmosphere. If the burden were sticking in the furnace and blowing were continued indefinitely a point would be reached where the burden would come crashing down the furnace shaft, the dirty gas bleeders would open and a very large quantity of filthy gas would be emitted to the atmosphere. Furthermore the furnace would subsequently produce a number of casts of off-grade iron. In order to avoid this disastrous situation the blast may be cut off momentarily at regular intervals; if the burden is showing a tendency to stick it would generally respond to this technique and free itself with a small "slip" of insufficient magnitude to cause the dirty gas bleeders to open. On some occasions, however, a furnace might be driving rather erratically so that the "slip" was large enough to cause the bleeders to open for a very short time. Burden preparation, which was extensively practised in the Scunthorpe district had greatly reduced the incidence of involuntary bleeding of dirty blast furnace gas and as still better preparation techniques were evolved the position would improve further.

R. L. Cooper said, in reply to Mr. Allen that it should be emphasized that the training courses referred to in the paper were relevant only to the mitigation of air pollution and that in all other respects the training of operators was a matter solely for the management. There was certainly no complacency, indeed over the industry as a whole one could sense a genuine interest in the problem. For example, several technical papers on the subject had been given recently and these had always been well attended. The response to the training courses offered by the Research Association had been excellent and training would be continued. Staff of the Association would be visiting plants at the invitation of the management to see the individual problems at first hand and we agree with Mr. Allen that much more remains to be done in training, and, may I add, research.

The booklet entitled "Practical Suggestions for the Reduction of the Emission of Smoke, Dust and Grit at Coke Ovens", which had been circulated by the Research Association, was a beginning and it gave ideas which the management could try out at their own plants, but the differences between plants means that each had its own individual problems. We agree that inefficient operation can result in pollution and we have endeavoured to point this out at every available opportunity.

In general we feel that the Research Association enjoys a great deal of goodwill and co-operation with the management and operators in the industry and that this bids fair towards an amelioration of this difficult problem.

F. M. Shaw said that Mr. B. D. Allen had emphasized that the ironfounding industry was made up of predominantly small units and this naturally adds to the difficulty of "cleaning up" the industry. Many small foundries had gone out of business in the last ten years but there still remained a considerable number (e.g. those in the under 200 tons of castings per year category) who could find the cost of wet arresters for their cupolas intolerable. It is difficult to give collection figures for any sort of cupola arrester since so much depends on the cupola and its operation, but it can be said that simple dry arresters markedly reduce roof deposits.

Cupola gases from even small cupolas fitted with any sort of arrester were normally discharged at heights of not less than 40 feet which compared very favourably with many examples of one type of boiler—the packaged unit.

Mr. T. B. Chaffe had raised the difficult question of cupolas situated in a valley with nearby houses above the furnace discharge level. As yet there was no completely satisfactory answer to this problem which had been proved in practice. Because of the considerable work being done by many firms it was to be expected that some at least of these especially difficult problems would be solved in the next few years.

AN INVESTIGATION INTO THE AIR POLLUTION AT GELEEN

(THE NETHERLANDS)

by L. J. Brasser and P. E. Joosting[*]

Introduction

IN Limburg, the south-easterly province of Holland, there is a coal basin, which actually forms one whole with the adjoining districts in Belgium and Western Germany. In the Dutch part more than 50 per cent. of the production is a bituminous coal with 20-25 per cent. volatile matter (a good coking coal). Annexed to the mines, coke plants and chemical industries have developed, causing air pollution.

In one of the places in this territory, *viz.*, Geleen (population 30,000) there has been an increasing interest in this subject during the last few years, because, bordering the residential areas, there is a mine with coke works, and a large chemical plant, causing nuisance and doing some damage to the local vegetation. Gradually, the question arose with the population and the local authorities to what extent the existing air pollution might be detrimental to health. Through unofficial channels this led to a kind of round table conference, when, under the auspices of the government supervision of the Mines, the parties concerned, *viz.*, the Geleen authorities and the management of the Mines and the chemical works, and a neutral body capable of representing the scientific research, *viz.*, TNO, came together. On other occasions such a setting also proved to be very beneficial. In this instance this form of conference has led to a research design in which all parties concerned showed considerable willingness and actual co-operation.

The municipal authorities, for instance, provided funds and administrative assistance, the mines provided facilities with measurements, TNO actually performed the majority of the measurements and was responsible for processing the results, while last but not least the local general practitioners assisted in compiling morbidity data. From the above it will be clear what surprising degree of willingness to co-operate can be achieved if the parties can be brought together in a round table conference in which neutral bodies are sufficiently represented to ensure an objective course of things.

We are pleased that in Holland TNO is generally recognized and accepted in such a function.

Measurements of the air pollution

The measurements can be roughly divided into 5 groups, viz:

A. Measurements with standard deposit gauges and Liège spheres;

B. Determination of the dust content of the air by means of an automatic filter;

C. Determination of the SO_2 content of the air by means of transportable equipment;

D. Determination of the NO_2 content of the air by means of wash bottles;

E. Determination of some other air pollutants by means of impingers.

ad A. In the Geleen area 9 fixed measuring stations were established, each being provided with a standard deposit gauge and a Liège sphere. The samples were invariably collected after one month and after 15 days.

The samples obtained were examined by laboratories of the State Mines so that an impression was obtained of the spreading of the air pollution over the territory examined during the year the measurements lasted.

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ad B. At a place where, according to the population, there was maximum dust nuisance, a measuring station was established at which by means of an automatic apparatus, air was sucked through a filter for periods of 2 hours. In this way, 12 samples per day were taken during a year, so that an excellent insight was gained in the course of the dust content of the air.

ad C. The SO_2 content of the air was measured for $1\frac{1}{2}$ weeks per month. This period was so selected as to cover the periods described below in which the general practitioners took their observations, as well as the days preceding the latter period. In order to reasonably cover the entire territory it appeared to be necessary to carry out the measurements at 36 different points. This was achieved as follows: A transportable apparatus by means of which the SO_2 concentration in the air could be measured directly, was placed in a vehicle. Each day of the measuring period the SO_2 concentration was determined for approximately 10 minutes at all 36 measuring points, it being seen to that, per measuring point, the moments at which measurements were carried out were spread over the hours of the day as much as possible.

In this way both an impression of the distribution of the SO_2 concentration over the time and of the spreading over the territory were obtained.

ad D. Since some of the chemical works bring NO_2 into the air and since these works are situated rather near each other the situation for this air pollutant was such that it can in fact be regarded as one single source of pollution. The measuring method was adapted accordingly by performing in each case measurements under the smoke plume. By doing so an impression of the maximum NO_2 concentration occurring under varied conditions was obtained. As was the case with the SO_2 determinations these measurements were performed during the week in which the general practitioners took theirobservations as well as during the days preceding this week.

ad E. A great number of determinations of different air pollutants was performed, mostly under the smoke plumes of certain works, by means of impingers.

The relative determinations of SO_2, sulphuric acid and solid soluble sulphate on the one hand and of the chloride, nitrate and fluoride concentration in the air on the other had a measuring time of one hour.

The results of the determinations of SO_2, sulphuric acid and solid soluble sulphate taken together were expressed as SO_2 concentration. By comparing these results with SO_2 concentrations measured in another way at the same place and time, it was found that expressing the sum total of the three determinations as SO_2 was justified. In other words, there was no substantial amount of sulphuric acid or soluble sulphate in the air.

Consequently this method of measuring—the measurements again being performed on the days the general practitioners took their observations and on the preceding days—gave an impression of the SO_2, chloride, nitrate and fluoride concentrations, at those places and moments at which a maximum for this concentration was to be expected.

Discussion of the measuring results

The measurements mentioned under A give a general impression of the pollution of the free air at Geleen and of the influence of the place and the season on the amount of pollution. Since the measuring periods do not coincide with the period during which the general practitioners took their observations described below, these results cannot be used for the investigation into a possible connection between air pollution variations and the incidence rate of morbidity.

The results showed that, in particular in some quarters, there was a distinct increased dust deposit at ground level.

With the measurements mentioned under B the concentration of fine dust in the air—not to be confused with the dust deposit mentioned above—appeared to be no ground for anxiety.

Apart from some particular cases no dangerously high concentrations of pollution were found among the measurements described under C, D or E.

Periods of moderately high pollutions were admittedly measured on several occasions, which, in view of the sources of pollution present, was to be expected.

The SO_2 determinations are in the first place eligible for comparison with the medical data, since these determinations cover the whole town. Data about concentrations of other pollutants can, moreover, also be compared with the records of the physicians, be it in each case for limited areas.

The medical part

After ample consultations with the local general practitioners it was decided to periodically record all findings in practice during the period October 1959—October 1960.

This was done each month for a week, each case being recorded regarding sex, age, street, complaint and diagnosis, new case and whether single or repeated consultations. In this way it would be possible to obtain a morbidity pattern for the above periods, viz., according to place and time, with the object to compare the same with the actual population at risk and the pollution patterns, as these were also recorded according to place and time in periods running roughly parallel to the former. The periods of collecting pollution data commenced a number of days before the medical recording. In this way it would be possible to ascertain to what extent preceding changes in the air pollution would be reflected in the state of health of the population during the succeeding or partly coinciding days.

For the general practitioners this involved a very great amount of work. Since there was a risk of difference in appreciation and the question would invariably arise as to what should and what should not be recorded, it was decided that all findings during consulting hours and all calls would be recorded diagnostic without discrimination. Afterwards, they were uniformly examined and coded by a TNO physician.

By the method used it became possible to obtain an impression of the incidence rates and the prevalence rates for all kinds of affections, and diseases. These could be examined per quarter and related to the population at risk. It may be helpful to observe that the population in Holland is fully administered. At Geleen a mechanical administration is available so that the local population could be completely described per quarter as to composition (sex and age).

It was also possible to record in the said period all changes regarding mortality, birth, internal and external migration and the like, this being of importance since 10 per cent. of the local population annually changes composition because of such changes.

Discussion of the medical results

As a preliminary result it can be announced that a first analysis of the medical data obtained (30,000 notes) suggests the differences in the state of health of the population per quarter are probably too slight to justify rigorous statements regarding the effect of air pollution.

The significance of the method used lies in the fact that the conception " effect on health " is here expressed in terms of consultation frequencies for any complaints in the general practice; in other words a criterion as objective as possible, based on the subjective necessity of securing medical assistance. Apart from patho-physiological investigations this is the most sensitive criterion that can be used when examining large groups of population. A further analysis of the measuring results and the medical data will show the relation between the sensitivity of the medical method used, the determining possibilities of the measuring technique and the actual levels and level fluctuations of the air pollution.

PROGRESS IN FRANCE

Evolution of the action undertaken since 1959 by the "Association pour la Prévention de la Pollution Atmosphérique"

by G. Levantal[*]

THREE years ago, in connection with the diamond jubilee of the National Society for Clean Air, M. Queret had the opportunity, as General Secretary of the "Association pour la Prévention de la Pollution Atmosphérique" (A.P.P.A.) to define, before an international assembly held in London, the task of this organization which, at the time, had only been in existence for one year.

Unfortunately M. Queret has been unable to attend the present meeting, so that I have been given the privilege of outlining the activities of our Association. You will recall that this Association, created by private initiative, has as President Professor Bugnard, Director of the French National Hygiene Institution. It includes highly competent personalities from the scientific and medical world as well as from Administration and Industry.

Its authority is growing steadily and the large extension of its activities was acknowledged, in April last, by the fact that it could obtain without the least difficulty the status of "Publicly Recognized Enterprise". No other official support could have shown in a more striking manner that its efforts were in the right direction and that the work already accomplished was considered of great value.

Instead of starting with a chronological record of events I should like to give you an idea of the way in which the whole problem fits into our national context.

The co-operation of A.P.P.A. with the French authorities has resulted in the passing, on August 2, 1961, of an Act for the control of air pollution and foul smells, called "Loi concernant la lutte contre les pollutions et les odeurs et portant modification de la Loi du 19 décembre 1917 relative aux établissements dangereux, insalubres et in commodes".

There existed already an Act of 19 December 1917 which forty-five years ago had started the fight against the dangers resulting from the activities of certain industries, but its field of activities did not cover domestic heating, non-classified factories, or of course, the air pollution caused by new sources of atmospheric pollution such as ionized radiations. On the other hand, the new law does not cover the control of noise which will be dealt with by a special legislation.

A.P.P.A. has been co-operating with the preparation of the new Act which takes the form of a "Loi-cadre" which defines only a framework of principles, the application of which will be completed by special decrees.

Without waiting for them the Préfet de la Seine took, in October 1961, a decision applying to Paris and the suburbs, and met the wishes of the population. The decision concerns particularly boiler houses and the performance of appliances used for domestic heating.

Dealing with special problems in other parts of the country, two essential principles are observed: the development of industry and maintenance of public health—which must be reconciled with the human factor.

Permanent action of A.P.P.A

Working groups

The A.P.P.A. in addition to the scientifical and technical committees in existence from 1959, created last year a third committee to study the effects of atmospheric pollution on cultures and animals. It is divided into three subcommittees: fauna, flora, and green spaces, each one respectively presided by M. Ferrando, Director, National Veterinary School, Alfort; M. Monchot, Professor of plant biology, National Agronomical Institution; and M. Chasseraud, Water and Forest general engineer and general engineer, Landscaping department, Paris and Seine district. The most eminent personalities of the agricultural, forestry and veterinary world have thus associated their efforts in a common attempt, encouraged by M. Pisani, French Secretary for Agriculture, who last March presided over a general assembly of this organization.

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[*] General Delegate of the A.P.P.A.

We must mention here, for it is external to A.P.P.A., the recent creation of a committee whose targets are partly the same as those of A.P.P.A. In fact, the necessity to co-ordinate at a high level and in full independence, initiatives shared between the most competent personalities and the delegates of very different associations, all directed towards protection of the land, led, last November, under the presidency of M. Heim, Vice-President French Sciences Academy and Director of the Natural History Museum, to the creation of a committee for the protection of land (forests, landscapes and, in towns, green spaces). The A.P.P.A. is represented in this organization.

Creation of " smokeless towns "

The A.P.P.A. intends, as has been done in several foreign countries, to create " smokeless towns " by helping local authorities in such matters as the determination of polluting elements, the control and supervising of the use of fuels, air purity control, etc.

This has been the starting point of a series of steps leading to the same end, either short term or longer term, in cooperation with technical organizations or services, particularly the committee presided by M. Louis Armand, Chairman of the Board of Directors of the Lorraine Coalfields, whose terms of reference include combustion problems and the committee headed by M. Gallienne, Chairman of the French Road Union which is studying all problems concerning carburation.

We must note, on this occasion that the French Government has extended its field of action, by asking the help of semi-public or even private organizations, regardless of their classification; some of them are fact committees.

Co-ordination of Action

Short term.—Study of an eventual substitution, for certain use, of fuels with high content in sulphur, by other products.

Action on space heating appliances (compulsory creation of an approval seal showing that the appliance conforms to standard regulations).

Compulsory regulation and replacement of obsolete space heating appliances.

Selection of compulsory fuels for use in public or administrative buildings; technical training for stokers and boilerhouse workmanship.

Long term action

In order to extend and increase its activities A.P.P.A. has established sections in Paris and several provincial towns:

(*a*) *Action Committee against atmospheric pollution for Paris and suburbs.*—This committee was set up early in 1960 under the presidency of Professor Besson, member of National Academy of Medicine. This committee collaborates with the Seine district prefectory which has decided the creation of smokeless areas in the Capital. Two " pilot-areas " have been chosen in the 11th and 16th districts. More than 300 points were selected for air test samples which are analysed by Parisian laboratories.

This action has found its extension in a wider geographical task: 1,200 collective boiler-houses, that is a fifteenth of those existing in Paris, have been visited in a few months and a persuasion campaign conducted, led by skilled technicians, from nationalized as well as private industry—let us hope with satisfying results.

(*b*) *Paris laboratories.* — A.P.P.A. works, in a limited way, with the two important laboratories in Paris, the Municipal Laboratory and the Paris City Hygiene Laboratory.

The Municipal Laboratory, under the direction of Professor Moureu, has led the way, for Paris area, in dealing with pollution due to motor vehicles. This difficult detection task is being conducted with real efficiency and has permitted a better estimation of the danger, which must be overcome by imposing stringent and rigorously applied regulations.

The Hygiene Laboratory, whose director is Doctor Coin, is, on the other hand, engaged in producing a map of atmospheric pollution. This work is of first necessity for the whole of France and must be conquered very rapidly. For all regions of France it must be done, in co-ordination with this laboratory, through estimates, samplings, air tests, measurements and analyses, by suitable laboratories and scientists such as doctors, chemists, and biologists. From this work it will be possible to determine progressively the exact extent of the danger and its nature in order to judge different ways of protection or cure.

(*c*) *Provincial organizations.*—In Lyons, a local committee was created in 1960. Its president is M. Pradel, Mayor of Lyon. Other committees have been set up in recent months in Strasbourg, Rennes, Arras and, near Paris, Boulogne-Billancourt, Vincennes and Saint-Maur. We must particularly mention a regional section " Toulouse-Pyrénées " which covers no less than eight districts.

In other places such organizations are initiated by the administration after conversations with A.P.P.A. It has already reported that the Loire district Prefectory at Saint-Etienne, had in 1959 instituted a sub-commission for atmospheric pollution.

This organization has pursued its activities in the neighbourhood, especially Roanne, le Chambon-Feugerolles, and Rive-de-Gier. These towns, after research on pollution levels and measurement, have started a clean air campaign,

At Pau, situated not far from Lacq, centre for the production and treatment of natural gas, a scientific commission presided by Professor Bugnard, which includes several members of the A.P.P.A. committee, has drawn up a programme of work, the execution of which is in the hands of the local laboratory.

A.P.P.A. supports also the creation of independent, local or district associations which seek to unify their policy with that of A.P.P.A. In the case for Versailles, under the presidency of Dr. Debat, an Association has been created with representatives of Industry, Senators, Deputies, Mayors and General counsellors.

At Rouen, A.P.P.A. is working in the same way with a local association presided by M. Daniel Lavallee, College Professor. Other developments are planned for a number of provincial towns, among which we must mention Nantes, Nice and Bordeaux.

From all these efforts is being born a network, always more and more complete, covering all France, and making it possible to detect and estimate pollution and begin to lower or prevent its effects.

Meetings organized by A.P.P.A. or held with its participation

In France

The National Congress of 1960, organized by A.P.P.A., was the first congress held in France for the campaign against atmospheric pollution, and took place in Paris on November 24, 25, and 26. This conference was attended by more than 700 participants.

46 communications were presented during the Congress, including six by specialists from foreign countries (Belgium, Germany, Great Britain, Italy, Portugal, Switzerland). Two foreign

delegations were also present (U.S.S.R. and Israel). The papers have been brought together and published in an important book that has become widely known and in good demand.

The French Public Health Secretary presided at the opening meeting and the final symposium, where he summed up the conclusions that were reached. The General Delegate of Scientific Research came and underlined all the attention he had given to the meeting. M. Louis Armand, President of the technical action committee against atmospheric pollution laid out clearly data of the problem in relation to economic needs and those of public health, hoping that by successive approximations they would find harmony between what was desirable and what was possible.

Participations

A.P.P.A. has participated in:

The 23rd International Congress of Industrial Chemistry (Toulouse and Bordeaux, October 1961).

Royaumont symposium (April 20 to 23, 1960), under the aegis of EUROTOX (European Research Committee for the protection of the population against the risks of long time intoxication). The French experts were Professors Bugnard, Moureu, Raymond, Truhaut and General Engineer Avy.

International Conference of Chemical Engineering, organized on April 27 last at the Maison de la Chimie, with A.P.P.A.'s assistance and participation.

Foreign countries

A.P.P.A. was represented by General Engineer Avy and M. Queret at the international congress held in Wiesbaden from September 21 to 23, 1960.

It was also represented by myself at the two congresses organized in Milan by A.S.H.R.A.E. (American society of heating—refrigeration and air conditioning engineers) the first in March 1961, the other in March 1962.

The Bochum colloquium, held from September 19 to 21, 1961, under the patronage of the German horticulture society, was attended by M. Hascoet from the National French centre for Agronomical Research, and an A.P.P.A. delegate. Finally, we went back to Italy twice, first for the Torino Congress organized by N.A.N.S. (United Nations for fight against noise and smog) and secondly for a colloquium, begun at San Remo and closed at Nice, on February 13, 14, and 15, 1962, under the aegis of the European Union for Social and Preventive Medicine and A.P.P.A. The French representatives were seven.

It would be inexcusable to close this enumeration without saying how glad I am to be among you in Harrogate.

By tightening our contacts with National Society for Clean Air, as with our other foreign friends, we follow together the way that will lead us, in the last months of 1963, to Strasbourg.

A European conference on air pollution will take place under the aegis of Consultative Assembly of Europe Council M. Queret, who came to London last May with Dr. Roussel, has already had with Mr. Marsh and other British personalities, very encouraging discussions. Problems, the solution of which appears to be urgent and which, subject to the final adoption of an agenda, appear particularly to call for attention, are:

Terminology and measurement units.

Standardization of measuring and controlling instruments—unification of measurement methods.

Influence of pollution on human health.

Effects on animals and plants (test stations).

Concentration at which toxicity begins.

Economical effects of pollution.

Meteorological conditions and pollution (microclimates).

Scientific methods to reduce pollution due to combustion (domestic heating appliances and boilers).

Scientific methods to reduce pollution due to carburation (motor vehicles).

Scientific methods to reduce pollution due to industries (cement, steel, etc.).

Green spaces (afforestation—acceleration of plant growth).

Organization or development of European co-operation in studies, standardization, documentation concerning the fight against air pollution.

Information methods for public education on the progress of the campaign.

Comparison of present national legislation and possibility of an harmonization for the purpose, if possible, of elaborating a European convention about air pollution.

This conference will have evidently to act as a guide on the best way for the study and progressive adoption, by every country, of the scientific, technical and legislative measures which are best for them.

In order to facilitate diffusion and to set in motion the first awaited results; and in order, also, to ensure their improvement, the creation of a permanent organization, highly authoritative by the quality of its members, is now called for by many. This organization would take the form of an international Union where your French friends should be particularly glad to meet you.

REPUBLIC OF IRELAND – AIR POLLUTION CONTROL

*F. E. Dawson, F.A.P.H.I., M.Inst.P.C.**

IRELAND is a country which until quite recently was almost wholly pastoral in character and indeed still relies to a very great extent on its agricultural industry. However, the rather slow industrialization of the period before the last war has been succeeded during the last 17 years by a very greatly increased rate of industrialization. This has resulted in acceleration of the drift from the land, although this, of course, is a factor common to all countries at present. It is interesting to note that between one-fifth and one-quarter of the population of the country resides in the Dublin conurbation. It is, however, the policy to encourage industry to seek locations away from the capital and there is a tendency for all urban areas to increase in population.

These factors must inevitably result in a greater concentration of air pollution from domestic and industrial sources, not to mention the rapid increase in mechanical vehicles and consequently, of exhaust fumes.

In 1956, partly as a result of visual signs of pollution in Dublin and Cork, and partly due to the knowledge of the factors mentioned in the previous paragraph, it was felt that an endeavour should be made to assess the pollution product in the State. This assessment was completed in 1957 and although a conservative approach was employed, the figures obtained indicated plainly that further investigation of a more precise and practical nature was essential.[1]

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* Superintendent Health Inspector, Department of Health, Irish Republic.

The Department of Local Government, therefore, decided to initiate a programme of observations of air pollution to obtain information not only on the present position but, if possible, on the trend. At first it was decided to restrict this programme to the largest centres of population and to extend it gradually to other areas where it was felt there might be air pollution. The main reason for beginning in this fashion was that the scheme was rather in advance of public opinion and the necessity for it was not immediately and visually apparent. In the event, with the co-operation of local authorities and the cement industry, observations were begun at four locations in Cork and Drogheda in 1958, although for various reasons 1959 was the first full year of operation. Since then the scheme has gradually been extended to embrace also Dublin, Dundalk, Limerick and Galway. These areas are covered now by 23 observation stations and it is expected that by the end of 1962 the number of stations will have risen in these six localities to 30. The position will then be that all the larger urban centres will be under observation.

The scheme makes use of the standard deposit gauge and lead peroxide instruments, though some of the additional stations, due for commissioning in 1962, will use the daily smoke and sulphur dioxide recording apparatus. The bodies co-operating in the scheme under the Department's aegis are local authorities; Regional Analysts, Irish Cement Ltd., Messrs. Guinness Ltd., and the Physics Department of University College, Galway. Liaison is also maintained with the other University Colleges, the Meteorological Service and the Electricity Supply Board. In addition, since 1960 a small number of limited surveys related to particular potential sources of pollution have been carried out by local authorities and the Electricity Supply Board.

It is still considered too early to express a definite opinion about the trend of air pollution but, from the results already obtained it can be said that there is a fair amount of pollution already in certain areas. Whilst these problems may not as yet have attained the severity of those in other countries, it is obviously advantageous to act as soon as possible so as to prevent, rather than belatedly to cure, a difficult situation.

It is, of course, impossible to control pollution without at least the background sanction of effective legislation and also a programme of public education. With modern methods of communication such as radio and television together with press publicity, it is becoming easier to impress the need for control action upon the public and some steps in this direction have already been taken. Legislation, however, is a rather different problem.

Legislation

Such legislation as already existed in the Republic regarding air pollution had been enacted before the State was constituted in 1921 and, as will be seen from what has gone before, there was no apparent necessity until recently for seeking much alteration in it. It was, however, completely inadequate for modern conditions and no doubt would have proved unsatisfactory in the past, had this country possessed the industrial and population problems of Britain.

In considering what useful form of legislation might be presented to the Dàil, certain points peculiar to the country had to be borne in mind. These were, firstly, that the industrialization position is in a somewhat fluid state, as is natural with a growing programme and the final pattern it would assume could not be foreseen; secondly, pollution at present is restricted to a comparatively small number of centres; thirdly, nothing should be done which would prevent or hamper the industrialization programme; fourthly, the financial position, as with all small States, would not permit the wholesale expenditure of money on large-scale grant aid for this purpose and fifthly, the question of staff required careful consideration.

For these reasons it appeared most realistic to plan legislation which would be flexible in character, both as regards the forms of control to be employed, the areas of their application, and the times at which these controls might be brought into operation. Since there are often many difficulties in the amendment of statute law due to the pressure on modern legislators, it was decided to suggest the passage of statute legislation of an "enabling" character. The intention was that with law of this character, detailed regulations on the various aspects of air pollution could be readily made and readily amended or adapted to meet various conditions as they arose. There are, of course, well-known objections to this form of government by regulation, but it was considered that the safeguards in this particular case would be sufficient to overcome these objections. Whilst the first intention was to draft a Bill relating solely to control of air pollution, for reasons connected with Parliamentary Timetables, etc., it was decided to take advantage of a short Bill relating to sanitary services which was in an advanced state of preparation. It was decided to append to it a portion relating to control of air pollution on the lines indicated above.

As a result, the Local Government (Sanitary Services) Act, 1962, contains the statute law for Ireland on the control of pollution of the atmosphere.

Section 10 of the Act states:

"10. 1. The Minister, for the purpose of securing the cleanliness of the atmosphere or the prevention of danger to health or injury to amenity from atmospheric pollutants, may make regulations for controlling pollution of the atmosphere.

2. Regulations under this section may, in particular and without prejudice to the generality of *subsection* (1) of this section, provide for all or any of the following matters:

(*a*) controlling sources of pollution of the atmosphere, including the emission of smoke, dust, grit or gas;

(*b*) regulating the establishment and operation of:
  (i) trades,
  (ii) chemical and other works, and
  (iii) processes (including the disposal of waste), which are potential sources of atmospheric pollution from smoke, dust, grit or noxious or offensive gases;

(*c*) specifying maximum concentrations of specified pollutants in the atmosphere;

(*d*) measurement of emissions of pollutants into the atmosphere;

(*e*) investigation of, and obtaining information on, emissions of pollutants into the atmosphere;

(*f*) testing, measuring and investigation of atmospheric pollution;

(*g*) regulating potential sources of pollution of the atmosphere from radioactive materials;

(*h*) specifying particular controls of atmospheric pollution for particular areas;

(*i*) licensing of persons engaged in specified works or processes, being works or processes discharging pollutants into the atmosphere, and prohibiting the engagement in such works or processes of persons other than licensed persons;

(*j*) licensing of premises from which pollutants are discharged into the atmosphere, and prohibiting discharge of pollutants into the atmosphere from premises other than licensed premises;

(*k*) the cancellation or suspension of licences;

(*l*) the imposition of charges for the purposes of the regulations or for services performed thereunder.

3. Regulations under this section for matters affecting industrial activities shall not be made by the Minister save after consultation with the Minister for Industry and Commerce and regulations for he matters referred to in *paragraph* (*g*) of *subsection* (2) of this section shall not be so made save after consultation with the Minister for Health.

4. Regulations under this section may provide for functions to be performed for the purposes of the regulations by Justices of the District Court, being functions relating to any of the following matters:

(*a*) the annulment or confirmation of cancellations or suspensions by sanitary authorities of licences,

(*b*) the direction of sanitary authorities to licence persons or premises in specified circumstances.

5. (*a*) Each of the following persons shall be an authorized officer for the purposes of this section:

(*i*) an officer of the Minister appointed in writing by the Minister to be an authorized officer for the purposes of this section.

(*ii*) an officer of a sanitary authority appointed in writing by the manager thereof to be an authorised officer for the purposes of this section.

(*b*) Subject to the next paragraph, an authorized officer (either alone or accompanied by such assistants as he thinks proper) may at all reasonable times enter and inspect any premises for the purpose of ascertaining:

(*i*) whether there is or has been on or in connection with the premises any contravention of any provision of the regulations made under this section,

(*ii*) the extent and nature of any such contravention, or

(*iii*) whether circumstances exist on or in connection with the premises which would require any action to be taken under such regulations.

(*c*) An authorized officer shall not enter any premises under this section unless he produces for inspection by the person in occupation or in charge of the premises, if such person requests him to do so, his appointment in writing as an authorized officer.

(*d*) A person who wilfully obstructs or interferes with the exercise by an authorized officer of a power conferred by this section shall be guilty of an offence and shall be liable on summary conviction thereof to a fine not exceeding twenty pounds.

(*e*) In this subsection—

" the manager " means—

(*i*) in case the sanitary authority is the corporation of a county borough, the manager for the purposes of the Acts relating to the management of the borough,

(*ii*) in any other case, the manager for the purposes of the County Management Acts, 1940 to 1955;

" premises " includes a ship or vessel.

6. A person who contravenes or wilfully obstructs the execution of a regulation under this section shall be guilty of an offence and shall be liable on summary conviction to a fine not exceeding one hundred pounds and, if the contravention or obstruction is continued after conviction, he shall be guilty of a further offence and shall be liable on summary conviction to a fine not exceeding five pounds for each day on which the contravention or obstruction is so continued.

7. An offence under this section may be prosecuted by the Minister or by the sanitary authority in whose sanitary district the offence was committed.

8. In any prosecution for an offence under this section, it shall not be necessary to negative by evidence any licence under regulations under this section, and the onus of proving any such licence shall lie on the person seeking to avail himself thereof.

9. For the purposes of this section and the regulations made thereunder, a ship or vessel lying in any river, harbour, or other water not within the district of a sanitary authority shall be deemed to be within the district of the sanitary authority whose district nearest adjoins the place where the ship or vessel is lying ".

In addition, the Schedule to the Act repeals the sections in the Public Health (Ireland) Act, 1878, relating to air pollution and the whole of the Alkali &c. Works Regulation Act, 1906.

As will be seen, the powers given to the Minister to make regulations are wide and it may be taken that they could be utilized, for example to provide controls for establishments which would normally come within the orbit of the British Alkali &c. Works Acts and Orders made under those Acts. In addition power is available to specify the concentration of particular pollutants in the atmosphere and to measure amounts of emissions. It would also be possible to make regulations relating to such matters as smoke control areas under Section 10(2) (h) and regulations requiring prior approval for the installation of new fuel-burning apparatus.

Provision is made for Appeals to Court in certain circumstances.

An important provision in the Act generally (section 14) is that " the Act shall come into operation on such day or days as may be fixed therefor by any Order or Orders of the Minister, either generally or with reference to any particular purpose or provision, and different days may be so fixed for different purposes and different provisions of this Act". Thus, powers in the Act, such as that under Section 10(g) which might not be necessary at present because, for example, there are no potential sources of pollution of the atmosphere from radioactive materials, need only be brought into operation when the necessity for them is seen to be imminent. Provision to appoint Advisory Committees or Consultative Councils is not contained in the Act, as the Minister already possesses general powers for making such appointments and he has in fact indicated that he is considering setting up an Advisory Body or Bodies.

It will be appreciated that the detailed implementation of the powers contained in the Act may, therefore, be spread over a period of some months or even years and at this stage it is not possible to do more than give an outline, as above, of the potentialities of the Act. It is felt, however, that this legislation represents something of a departure from the usual type of law relating to air pollution, and that due to its flexibility, further changes in the statute law should be unnecessary for many years to come.

Staffing, of course, will in the initial stages require careful consideration although, insofar as the functions of the local authorities are concerned, much if not all of this work will fall to the existing health inspectorate. It may, however, prove necessary to recruit additional staff for the functions reserved to the Central Government.

It should not be assumed from what has gone before that no practical steps have as yet been taken to reduce individual sources of pollution in the Republic. A good deal of work has been done, particularly in relation to industrial installations by the exercise of the " bad economics " approach, particularly regarding solid fuelled installations. Most of these cases have been successfully dealt with despite the lack of specific legislation but this is a process which cannot be continued indefinitely. With the new powers contained in this legislation, it will now be possible to deal positively and effectively with our pollution problems.

REFERENCE

[1] DAWSON, F. E.—" Air Pollution In Ireland—An Assessment "—*Administration*, Dublin, 1958.

PROGRESS IN WESTERN GERMANY

Report on the Directives of the V.D.I. Clean Air Commission

From the Commission

PARAGRAPHS 16, 24 and 25 of the industrial regulation (GO)*, along with the ruling for the amendment of the industrial statute dated December 22, 1959 came into force on June 1, 1960 under a new draft; these constitute the most important legal basis providing measures for the preservation of air purity in the German Federal Republic.

In 1960 on the basis of paragraph 16 (GO) a ruling was issued on plants subject to special licence, the latter contains a catalogue of installations, the erection of which requires special authorization. The principles according to which such approval is reached are laid down in a " Technical Manual " which is still in preparation and which rests on rulings subject to discussion by the VDI Commission for Clean Air. In addition to this directives are published for such categories not covered by paragraph 16 (GO). These include for example: Domestic fires and fuel, motor vehicle exhaust gases; directives also of more general content, *i.e.*, definitions, list of sources for impurities in the atmosphere.†

In the industrial ruling itself, which has legal force, no numerical boundaries relating to emissions and immissions‡ are mentioned. Reference will be made to the VDI-directives in the " Technical Manual." The values of limitation in the rulings can at any time be adapted to suit the current state of technology and scientific knowledge.

The complex nature of the range of functions covered by the VDI Commission and the problems dealt with in the directive makes necessary the collaboration of scientists and technicians from the most divergent spheres of specialized knowledge. Working together in the Commission besides many others are doctors, veterinary physicians, biologists, hygienists, botanists, physicists, chemists, meteorologists and engineers from the most varied technical backgrounds.

*The directives published by the VDI Commission for Clean Air are divided into the following main groups:

1. Maximum immission-concentrations (MIK) marginal values for concentration and the precipitation of impurities.
2. Spread and dispersion of impurities in the atmosphere.
3. Limitation for the deposit of impurities.
4. Analysis and measuring processes.

MIK = Maximale Immissions-Konzentrationen (*Translator*).

In assessing problems of air contamination attention should be given to the intrinsic relationship between these four groups. In the preamble to the MIK-rulings it is pointed out that:

" The VDI rulings for maximum immission concentrations (MIK) deal with the establishment of marginal values for definite cases of air pollution. The MIK values for air contaminating substances are defined as those concentrations in the ground level strata of the free atmosphere as in the case of dust and also those quantities of atmospheric impurities (fall out precipitation) in the vicinity, which in the light of past experience and after the effects of a definite period of time and frequency prove harmless to human beings, animals and plant-life.

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* Gewerbeordnung — industrial (trade) regulation (*Translator*).

† luftfremder Stoffe (this is translated in later paragraphs by the word " impurities ") (*Translator*).

‡ " Immission " accor VDI ruling 2104 (May, 1962) is defined as the occurrence of solid, liquid or gaseous air polluting substances predominantly active near ground level.

* Summarized in the VDI Handbook for Maintenance of Air Purity, obtainable through Beuth-Vertrieb GmbH, Köln, Friesenplatz 16.

Concentrations of air polluting substances in the free atmosphere vary fairly widely. For technical reasons to do with measurement it is expedient to establish marginal concentrations as mean averages for definite intervals of time. As a rule in the case of gaseous substances a marginal value is given for each effect, for lasting effects and those of short duration.

The marginal value for lasting effect (MIK_D) is the maximum permissible average concentration in the allotted measuring time interval (for example, a half-hour average) under continuous conditions of reaction.

For shorter periods the marginal value with many substances, during continuous conditions of reaction can be safely exceeded. Owing to the varying nature of the effect exercised by the substances and also owing to reasons connected with measuring technique, the duration, degree and frequency with which the above value might be exceeded cannot be laid down with any consistency.

Title of the directive	Marginal values for the effects
Maximum emission— Concentrations (MIK); Nitrous gases. $MIK_D=$	Duration Steady value: 0·5 cm^3/m^3∼1 mg NO_2/m^3 air as half-hour average.
VDI.2105. Issue May, 1960. $MIK_K=$	Short time value (permissible excess of steady value): 3 times per day one half-hour average of 1·0 cm^3/m^3∼2 mg NO_2/m^3 air.
Maximum emission— Concentrations (MIK); Chlorine gas. $MIK_D=$	Duration Steady value: 0·1 cm^3/m^3∼0·3 mg Cl_2/m^3 air as half-hour average.
VDI.2106. Issue September, 1960. $MIK_K=$	Short time value (permissible excess of steady value): 3 times per day one half-hour average of 0·2 cm^3/m^3∼1·6 mg Cl_2/m^3 air.
Maximum emission— Concentrations (MIK); Hydrogen Sulphide. $MIK_D=$	Duration Steady value: 0·1 cm^3/m^3∼0·15 mg M_2S/m^3 air as half-hour average.
VDI.2107. Issue April, 1960. $MIK_K=$	Short time value (permissible excess of steady value): 3 times per day one half-hour average of 0·2 cm^3/m^3∼0·3 mg/m^3 air.
Maximum emission— Concentrations (MIK); Sulphur dioxide. $MIK_D=$	Duration Steady value: 0·2 cm^3/m^3∼0·5 mg SO_2/m^3 air as half-hour average.
VDI.2108. Issue November, 1961. $MIK_K=$	for short time effects: permissible excess of steady value within 2 hours each time one half-hour average of 0·3 cm^3/m^3∼0·75 mg SO_2/m^3 air.

On the basis of accumulated knowledge other conditions have been found to apply in establishing MIK values for dust deposit. So in principle the testing time intervals must be extended for a longer period.

Owing to individual constitutional and environmental differences the MIK values only hold valid within a specified area of scatter. They do not constitute in themselves any criterion for assessing hypothetical damage caused by immission. If in such cases MIK values are drawn upon, this should be done with reference to all the attendant circumstances and only by specialists who are conversant with the relevant problems.

Determining factors in the establishment of MIK values are those observations and findings which are drawn up for an isolated instance in the occurrence of an atmospheric impurity.

It is known, that where several impurities are present simultaneously the total effect under certain circumstances is changed and owing to the large number of possible combinations standard values for a mixture of impurities can only be drawn up in special cases."

Subsequent pages list the most important specifications from the VDI-directives so far published "*Maximum immission-concentrations (MIK)*."

The regulations contained in the heading "*Spread of impurities in the atmosphere*" will include the basis for calculating the minimum height required by smoke stacks.

The extensive research work which is needed for drawing up these directives has not yet been completed. VDI-directives for "*Limiting the deposit of impurities.*"

To facilitate for the non-specialist, who is working on a specific specialized sphere dealt with in a directive the task of assessing the emission conditions of a certain installation, under item 1 of these directives are described the plants and processes which lead to the origin and deposit of impurities. Under item 2 are given measures for the abatement of impurity deposit and directions for the choice and maintenance of suitable waste gas cleaning plants.

Under item 3 are laid down conditions and standard values for the limitation of impurity deposit in new installations.

These conditions contain in principle two requirements. The first requirement (Item 3.1) lays down that the maximum admissible degree of impurity (MIK value) caused by emissions from a specified plant outside the area of the emitting source must not be exceeded. This condition therefore makes immission on the adjacent site a criterion for admissible emission and thus corresponds to the basic requirement of regulations pertaining to the protection of adjacent domains. In assessing emission from this viewpoint the saturation of the area prior to this by the respective impurity must also be borne in mind.

The second requirement (Item 3.2) lays down that in each instance everything that is technically possible and economically practical must be done by the manager of the plant to hold emission in check.

This principle relating to the limitation of deposit must in some cases be modified as for example in the limitation of certain exhaust gas ingredients from motor vehicles and deposits from domestic fires.

In the subsequent listing of published VDI-directives for the reduction and limitation of emission only those deposit values and conditions mentioned under item 3·2 are raised.

In all these directives the condition reads according to item 3.1 (with only a few exceptions) as follows:

Reduction of deposit on the basis of immission

Gaseous deposits, particularly SO_2

In the neighbourhood of an installation the maximum SO_2 concentration in the ventilating air (which is laid down in the VDI-specification 2108 "*maximum immission concentrations (MIK)*;" Sulphur dioxide) must not be exceeded.

Dust

The admissible dust deposit of a plant or a new operational installation must be reduced according to admissible fall out volume or concentrations in the vicinity and also according to conditions of propagation governed by the plants' location (orographic position and meteorological conditions). Here the density already present and the admissible dust density in the area must be borne in mind. In addition attention must be paid to the limiting values covering admissible immission concentrations for special deposits (MIK-values). This method of determining the deposit limit according to precipitation takes into account the natural inter-relationship between deposit, dispersion and precipitation.

Title of directive	Conditions and determining factors for the limitation of deposit
Limitation of dust deposit; Coking plants. Screening, crushing and grinding installations for coke. VDI.2100. Issue Sept. 1962.	The dust removal plants should be designed in such a way that the dust content of exhaust air during continuous operation does not exceed 0·15 g/Nm^3.
Limitation of gas discharge; hydrogen sulphide and other sulphurous compounds besides sulphur dioxide. Coking plants and gas works. Coal plants. VDI.2109. Issue May, 1960.	Apparatus and pipes subject to the (through) flow of coke oven gas or gases containing a higher concentration of hydrogen sulphide are closed systems, from which normally sulphurous compounds cannot escape into atmosphere. Such compounds can on the other hand be emitted from various points in the coal preparation plants, (during operational hitches (hold ups) for example) owing to the escape of discharged gases and gas escape from liquids. From this follows the establishment of fairly general measures for the abatement and avoidance of emissions; these have been combined under one table.
Limitation of gas discharge; Sulphur dioxide. Coking plants and gas works. Coke ovens (waste gases). VDI.2110. Issue August, 1960.	In particular provision should be made in the case of newly planned coking plants for the partial desulphurization of coke oven gases designed for undergrate firing.
Limitation of dust deposit; Coal briquette factories. VDI.2292. Issue October, 1961.	The dust content of clean gas must not exceed 0·3 g/m^3 during continuous operation after passing through the vapour cleaners and the dust content of clean gas must not exceed 0·15 g/m^3 during continuous operation after passing through the dust removal installation for surrounding air and vapours.
Limitation of dust deposit; Preparation plants for coal (bituminous). VDI.2293. Issue October, 1961.	The dust content of the cleaned exhaust air from normal air and filter air dust removal installations must not exceed 0·15 g/m^3 during continuous operation and the dust content of clean gas after passing through the vapour dust removal installations must not exceed 0·3 g/m^3.
Limitation of deposit for dust, tar mist, and gases accumulating on the charging of coke ovens. Coking plants and gas works. VDI.2302. Issue June, 1962.	Newly erected coke oven blocks must be equipped with installations which effectively prevent the leakage of charging gases. Generally, in charging operations (according to available experience) this aim cannot be achieved, if the charging gases are drawn off through only one uptake pipe in the coke oven waiting to be charged. The escape of charging gas on the other hand can be to a large extent reduced if the (charging gases) are drawn off through an opening situated as far away as possible from the leveller opening in the oven roof. The extracted charging gases can be led off into the crude gas, then burnt or after scrubbing be drawn off into the open air. In running operations the

Title of directive	Conditions and determining factors for the limitation of deposit
	volume of charging gas encountered is much greater than in charging operations. According to present technology however by leading the charging gases off into the crude gas leakage can to a large extent also be reduced in running operations.
Limitation of dust deposit: Generators. Coking plants, gas works. VDI.2290. Issue June, 1962.	*Dust:* In generator plants under project the dust content of waste gases during continuous operation must not exceed 0·20 g/Nm^3. *Sulphur dioxide:* The SO_2 discharge is dependent on the sulphur content in the fuel. At present no technically verified methods are known, which could bring about a reduction of the discharge. Should such methods prove successful in the future they must be tabled for consideration.
Limitation of sulphur dioxide discharge; Plants for the production of sewer gas (Stadt gas). Coking plants and gas works. VDI.2291. Issue October, 1962.	The SO_2 content of waste gases is dependent on the sulphur content in the charging products and can be reduced by using products of low sulphur content. All measures which are technically possible and economically practical should be taken to limit SO_2 discharge.
Limitation of gas discharge; Chlorine gas. VDI.2103. Issue January, 1961.	All waste chlorine gas occurring within a plant must be led into an appropriate installation, where it can be absorbed, and, if necessary, rendered harmless. The remaining chlorine content in the cleaned waste gases must not exceed a total of 1 cm^3/m^3$\sim$3mg/m^3 (1 cm^3/m^3 (=1 ppm)$\sim$ 3 mg/m^3).
Dust discharge blast furnace operation; Ore sinter plants (induced draught ladles and strip plants). VDI.2099. Issue October, 1962.	Because of the fluctuating operational conditions in the sinter plants it has not so far been generally possible to keep to the value aimed at for the dust deposit of 150 mg^3 per Nm^3 sinter waste gas, even though the plants have been built according to most recent technological standards. Under present operational stipulations in sinter plants under project the dust content in sinter waste gas during continuous operation must not exceed 300 mg/Nm^3. The dust removal plants must however be laid out in such a manner that, under normal operational stipulations the dust content in sinter waste gas does not exceed 150 mg/Nm^3. In removing dust from surrounding air a dust content of 150 mg/Nm^3 must not be exceeded.
Dust deposit; Iron works; Blast furnaces. VDI.2099. Issue February, 1959.	The maximum permissible dust content for furnace plants under project must not exceed 20 mg/Nm^3 in pure gas during continuous operation and 50 mg/m^3 in waste gas from furnaces fired by blast furnace gas and blast furnace gas engines, etc. In the same way the blast furnace gas must be thoroughly cleaned before igniting.
Limitation of dust deposit; Cupola furnaces. VDI.2288. Issue October, 1962.	In the diagram (Fig. 1) "Limitation of dust deposit for cupola furnaces under project" is given the maximum permissible dust deposit for a new installation. Cupola furnace plants which are entirely new or substantially rebuilt qualify as new installations subject to special approval according to paragraph 25, sub-paragraph 1. 4. Trade and industrial reg. (Gen. O.). The frequently uncontrolled quantities of entrained air contained in the waste gas compel specialists to abandon the term "specific dust content" in waste gas when dealing with cupola furnaces. For this reason the maximum permissible volume of dust deposit is expressed in the specifications of limit in kg/t iron. The decision regarding the choice of the dust removal factor can at times only be reached by taking into account the

Title of directive	Conditions and determining factors for the limitation of deposit
	volume of blast furnace gas per ton iron, the attenuation rate and the crude gas dust content. In cupola furnaces requiring partial utilization of blast furnace gas as in hot blast cupola furnaces for example the specific dust content of the furnace waste gases and the waste gases accumulating from blast furnace gas utilization (Recuperator for example) including the volume of waste gas already present must be dealt with separately and from the results the dust removal value must be determined. To make allowance for the size of the plant and also for the fact that a large number of cupola furnaces have only one layer and are often operational for only a few days in the week, the maximum dust deposit (ordinate) has been given in the diagram as a function of the hourly melting capacity of the cupola furnace (Abscissa) for various working hour factors of the cupola furnace plant. The melting capacity must correspond to the nominal capacity and the working-hour factor to the nominal working-hour factor (published in the Supplement to the certificate of authorization, outlining the plan of operation).
Can sometimes be omitted	(*a*) A cupola furnace plant consists as a rule of one to three (usually two) furnaces of roughly the same hourly melting capacity out of which however always one is in operation. The total number of working hours of each single furnace counts as the working hour factor of the cupola furnace plant, and it is irrelevant whether the plant possesses communal dust removal facilities or whether the dust is removed from the individual furnaces separately. Evidence of the working hour factor must be indicated, by melt-recordings for example. (*b*) If several cupola furnace plants operating simultaneously but independently of each other are comprised in one melting operation and if the removal of dust from all the furnaces in operation is technically possible and economically practical in one communal dust collector, then the total number of melting times from all the furnaces served by the dust removal plant is valid (according to the diagram) as a working hour factor for the determination of the permissible dust deposit. If the centralization of all the furnaces in a common dust removal plant is not technically possible and economically practical the individual furnace plants (furnace pairs for example) of the entire melting operation are dealt with separately as under (*a*).
	An extrapolation of the boundary lines concerning the range of the diagram will not be given. In this case special arrangements should be made. This holds true especially for installations which have been under operation for less than 1,000 h/year. (See Fig. 1).
Limitation of deposit. Zinc works. VDI.2284. Issue September, 1961.	In the case of newly erected calcining furnaces it is important to see that all the gases are treated for the extraction of sulphuric acid. In plants under project the following attached dust contents in waste gases must not be exceeded during continuous operation. *Roasting works and sinter plants:* It is not necessary to give a marginal value, since in new installations waste gases containing dust no longer occur. *Zinc plants with horizontal retorts* Marginal value not necessary, since new zinc plants with horizontal retorts of the above design are no longer envisaged. *Zinc plants wiith vertical retorts:* Total waste gas 0·4 g/Nm^3. In new plants further improvements are expected. *Electrothermal zinc extraction plants:* Condenser waste gases after combustion 0·1 g/Nm^3.

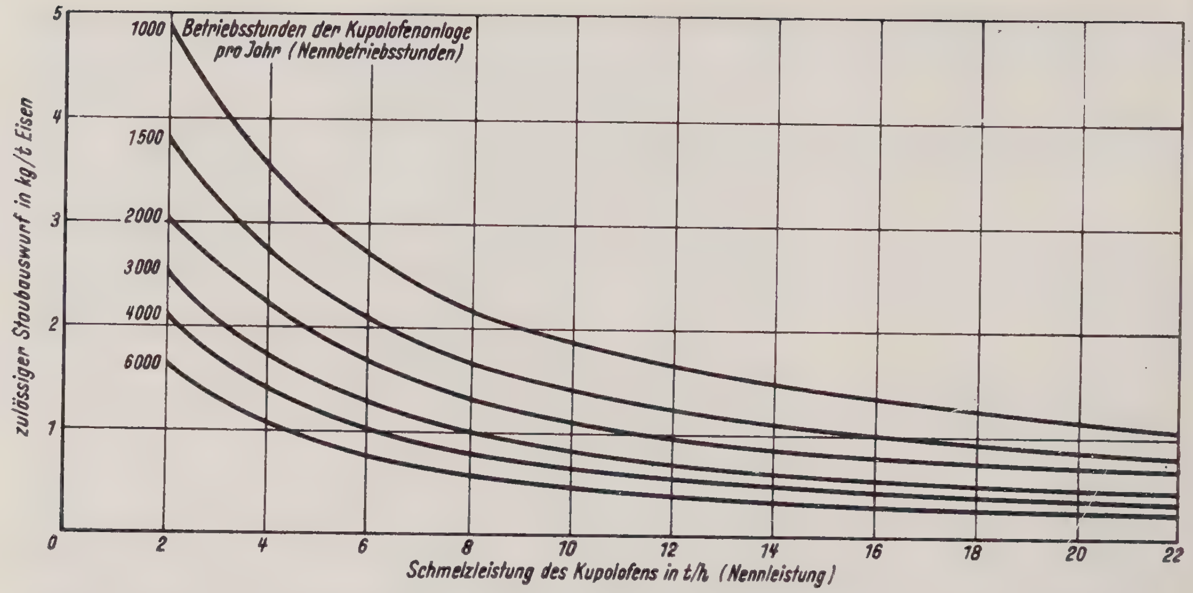

Fig. 1. Limit of Dust Emission for Cupola Furnace Plants under project

Title of directive	Conditions and determining factors for the limitation of deposit
	Fine zinc distillation plants: Furnace combustion waste gases 0·2 g/Nm³. *Rolling plants:* Total waste gas 0·5 g/Nm³.
Limitation of deposit; Lead refining plants. VDI.2285. Issue September, 1961. insert	In the case of newly erected calcining furnaces it is important to see that all gases from roasting are treated for the extraction of sulphuric acid. In plants under project the following attached dust content in waste gases must not be exceeded during continuous operation. *Lead ore roasting and sinter plants:* It is not necessary to give a marginal value, since in new installations waste gases containing dust no longer occur. *Kilns:* 0·4 g/Nm³. *Lead refining:* Copper removal, Silver removal, Zinz removal: { Furnace combustion waste gases 0·2 g/Nm³. Reverbatory or revolving reverbatory furnaces 0·4 g/Nm³. Slag blowing blast furnace plant 0·1 g/Nm³.
Limitation of dust deposit Boilers over 10 t/h capacity Coal (bituminous) firing furnaces with undergrate draft and travelling grate. VDI.2091. Issue November, 1961. Coal (bituminous) and coal dust firing furnaces with dry ash disposal. VDI.2092. Issue November, 1961. Coal (bituminous) coal dust firing furnaces with wet ash disposal. VDI.2093. Issue November, 1961. Coal (lignite) coal dust firing furnaces with dry ash disposal. VDI.2096. Issue September, 1962. Coal (lignite) grate firing	In the diagram (Fig. 2) "Limitation of dust deposit for plants under project" the maximum permissible dust deposit in a new plant is represented as a function of the quantities of ash produced by the furnaces of the entire plant. In order to determine the quantities of ash in the entire plant, the maximum continuous output of the steam generating plant is taken as a basis. The permissible volume of dust deposit for the new installation is derived from the percentage value (given in the ordinate) which is related to the volume of ash yield in the new plant. (see Fig. 2).

furnaces mechanical grates with downdraught. VDI.2097. Issue September, 1962.

Coal (lignite) grate firing furnaces stationary or mechanical grates without downdraught. VDI.2098. Issue September, 1962.

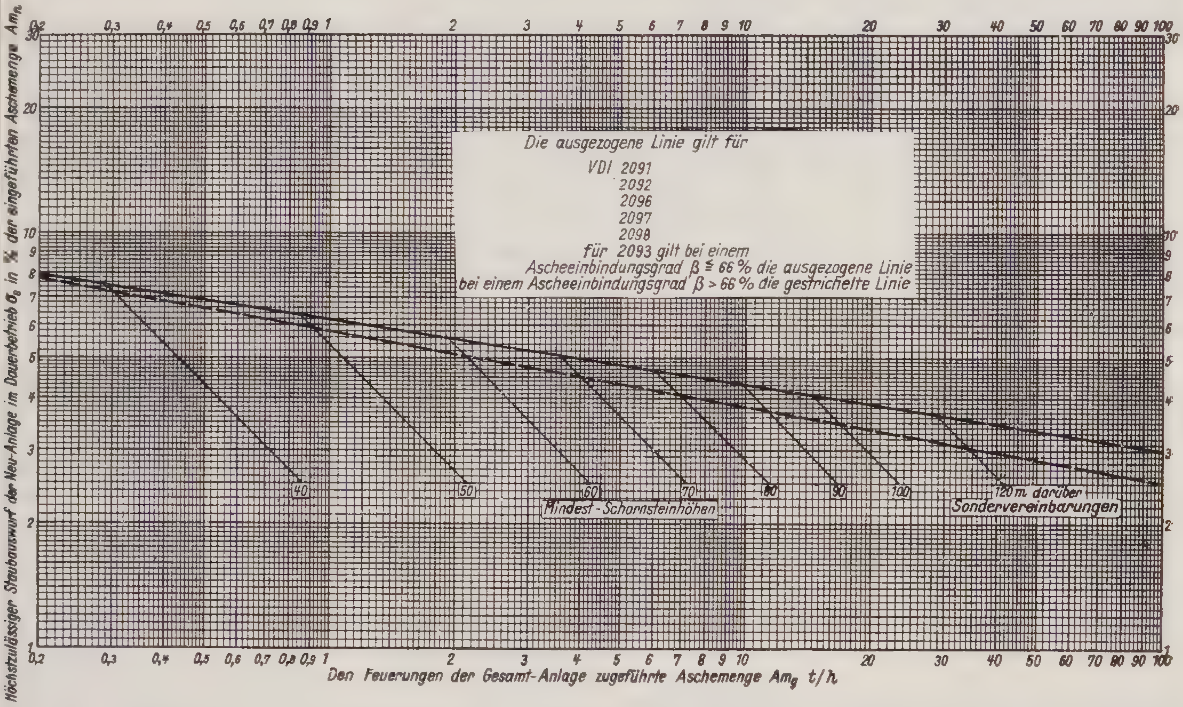

Fig. 2. Limit of Dust Emission for Plants under project. Multiple flue with internal grates

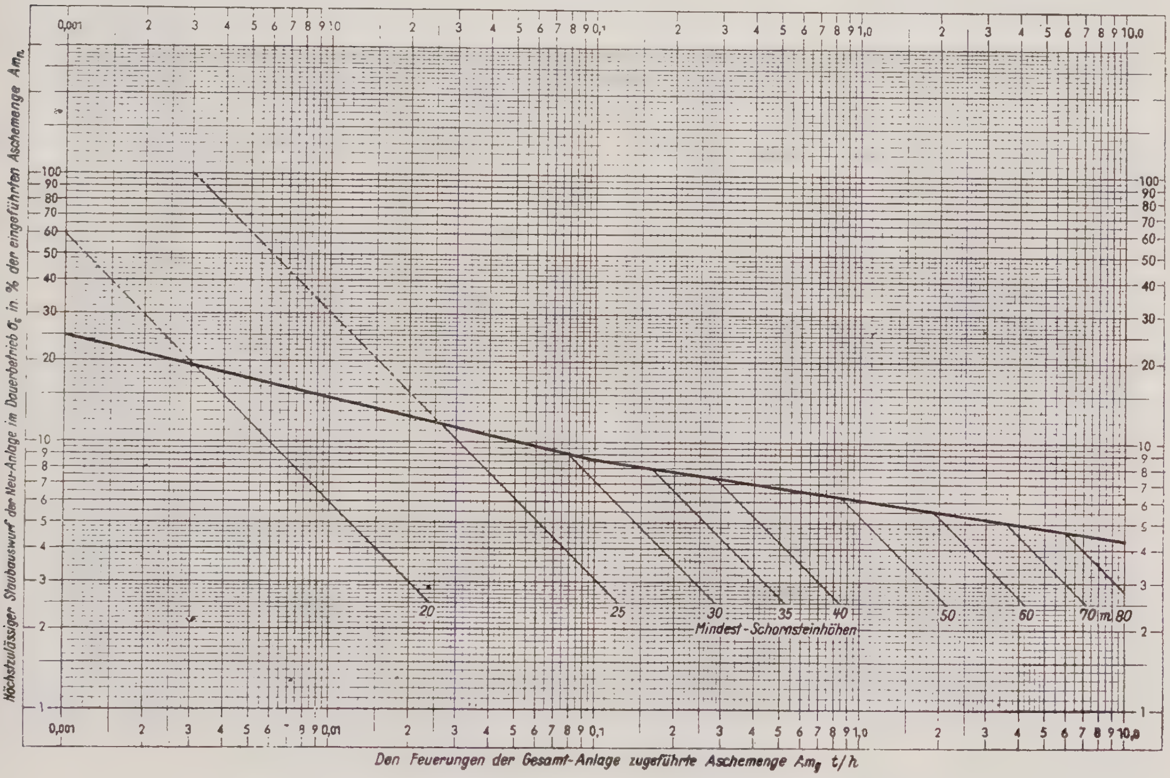

Fig. 3. Limit of Dust Emission for Plants under project

<table>
<tr><th>Title of directive</th><th>Conditions and determining factors for the limitation of deposit</th></tr>
<tr><td>Limitation of dust deposit.
Steam generators below 10 t/h capacity.
Multiple boilers for solid fuels with enclosed grate firing furnaces.
VDI.2300. Issue October, 1962.</td><td>Text, see: Directives steam generators above 10 t/h capacity. Limitation curves . . . see Fig. 3.</td></tr>
<tr><td>Limitation of dust deposit; Cement industry.
VDI.2094. Issue June, 1961.</td><td><i>Furnaces:</i>
The permissible dust deposit of a new furnace is taken from the diagram "Limitation of dust deposit for furnace installations under project" (Fig. 4) in percentage relating to clinker production. The values determined from the diagram should not be exceeded. How this is done, is left to the designer or buyer of the new plant. Factors contributing to this will be the choice of combustion processes as well as type, size and performance of the dust remover.
<i>Other plants of the cement industry:</i>
In the case of plant equipment like dryers, grinders, crushing machines, conveyors, coolers, silos and packing machines, the dust content in waste gases, exhaust air for example, must not exceed 0·15 g/m³.</td></tr>
<tr><td>Limitation of dust deposit; Hand operated central heating boilers with capacities of up to approx. 600,000 kcal/h.
VDI.2115. Issue June, 1961.
Can sometimes be omitted</td><td>When coke and anthracite are burnt the fine dust deposit is so slight that the establishment of a limit is not necessary.
When other carbonaceous materials such as peat and wood are burnt under poor conditions of combustion the deposit of dust and soot can lead to a visible decolorization of the waste gases. This decolorization makes it possible to employ the Ringelmann visual comparison (test) method.
The maximum permissible black density level in the waste gases on burning carbonaceous materials rich in gas (such as peat and wood) must lie below number 2 in the Ringelmann scale.</td></tr>
<tr><td>Limitation of dust deposit; Central heating boilers and air heaters (oil-fired).
VDI.2116. Issue June, 1962.</td><td>The dust and soot content of waste gases from oil-fired installations (measuring takes place at the end of the boiler or air heater; same measuring position as for CO₂). Should not exceed the density (based on the (Bacharach) filter paper method) corresponding to values given in the table below:
<table>
<tr><th rowspan="3"><i>Conditions</i></th><th colspan="2"><i>Max. soot level according to Bacharach</i></th></tr>
<tr><th colspan="2"><i>Fuel oil</i></th></tr>
<tr><th><i>EL and L</i></th><th><i>M and S</i></th></tr>
<tr><td>in continuous operation . .</td><td>3</td><td>4</td></tr>
</table>
For the starting up period in a cold installation or for reheating up to maximum after a period of standstill in the burner of more than 3 hours the values as shown above should be exceeded by 2 units for maximum duration of 2 minutes.
In oil-fired installations with 2 point burner control the nominal soot value calculated during several switch procedures each hour after periods of 30 seconds from the restart of the burner must be redetermined for continuous operation.</td></tr>
<tr><td>Limitation of dust deposit; Fire installations for liquid fuels with vaporization burners.
VDI.2117. Issue June, 1962.</td><td>The waste gas dust and soot content, measured at one end of the firing installation should not exceed the black density value 4 according to the (Bacharach) filter paper method for the total range of adjustment. The filter paper after measuring the soot factor should be free from oil.</td></tr>
</table>

Title of directive	Conditions and determining factors for the limitation of deposit
Limitation of dust deposit Small and medium sized refuse incinerator VDI.2301. Issue September, 1962. Can sometimes be omitted	When burning various types of refuse the fine dust deposit can (which also was the case under poor conditions of combustion) lead to a visible decolorization of the waste gases. This discolorization should not exceed specified degrees of density; the latter can be determined according to the Ringelmann visual comparison method. The maximum permissible density level in the fumes during continuous operation (this applies to the burning of all types of refuse) must lie below number 2 on the Ringelmann scale. Only during the starting up period for a maximum duration of 3 minutes in cold and a maximum of 2 minutes in hot furnaces is the smoke density permitted to reach number 2 on the Ringelmann scale or exceed it slightly.
Can sometimes be omitted	Through the application of an optical apparatus containing a built in filter plate in three sections, which corresponds to the specified values on the Ringelmann scale, the smoke streamer under observation can be sighted and the density level can be determined quite simply. As an additional measuring process the gravimetric method should be mentioned. It is employed in extreme cases and when difficulties are encountered regarding dust deposit. When this method is used the temperature of the waste gases must be taken into account. The fine dust deposit in the smoke stack opening must not exceed 200 mg/Nm³ fume. This value is related to fumes containing 7 per cent CO_2. If larger volumes of sulphur dioxide or other gaseous air polluting impurities in waste gases from a particular type of refuse are envisaged then the VDI rulings for maximum emission concentrations (MIK) valid for these substances should be observed. Offensive smelling constituents in the fumes are generally formed as a result of incomplete combustion. A complete and thorough combustion of the gases is ensured by a process of after burning.
Limitation of fume development from diesel motor vehicles. Causes of fumes, measuring processes, remedial measures. VDI.2281. Issue November, 1961.	In assessing the waste gas fume density of diesel automobile engines on the highway, the "marginal values of black density" according to Fig. 5 are to be taken as a basis under no operational conditions may they be exceeded.

The directive group heading "*Analyses and measuring methods*" deals with directions for the measurement of emission and immission concentrations of atmospheric impurities. Suitable equipment and including dispersion latitudes are mentioned; directions for the taking of readings including the planning of plotting centres are given and possible sources for error are indicated.

The directives "*Specifications for size in technical dusts*" (compiled by the VDI special authority "Dust technology") and "*Measurements of dust precipitation*" are being prepared for publication.

Owing to the multiplicity of prob-

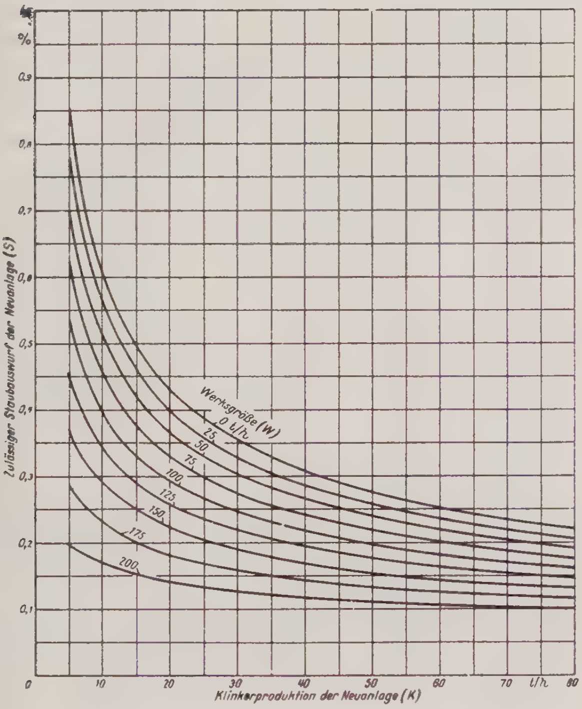

Fig. 4. Limit of Dust Emission for Furnace Installations under project

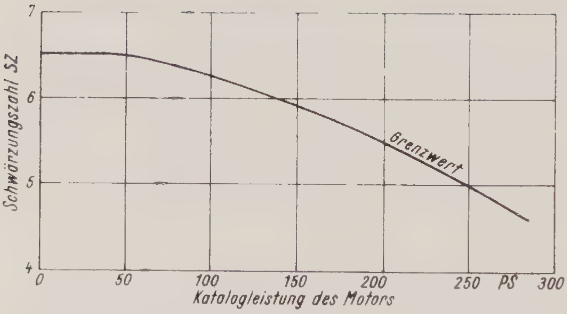

Fig. 5. Limiting values for blackness from diesel vehicles—blackness related to catalogue performance of engine.

lems which come up in connection with questions dealing with the maintenance of air purity the completion of the directive will still require a little time.

Since the directive should conform to the present standard of science and technology, supplements and corrections will continually need to be inserted. It is hoped however in the Federal Republic that with this flexible system the requirements may best be met.

THE PROBLEM OF SMOKE IN THE GERMAN IRON AND STEEL INDUSTRY

*by Dr-Ing. Kurt Guthmann**

DURING the last few decades atmospheric pollution within the iron and steel industry has grown into a very serious problem for workers on the plant and also for the neighbouring population. This is due to conditions caused by waste gases, smoke, fumes and dust, which are damaging to health and are a source of annoyance to those in their immediate place of work or living within the area of emission. Public attention has been focussed on this problem. The emission of dust and gas as a consequence of the advances made in industrialization as well as the expansion of industry and the conglomeration o large close-knit populations in industrial areas has become the visible occasion for a new campaign which is devoting itself to fighting the unthinkable and health destroying effects of air pollution.

After the second world war began the amazing triumphal entry of *oxygen into the steel plants* of the large industrial states, bringing in its wake the great advantages of increased capacity and improved quality, but also giving rise to the necessity of brown smoke. The technical superiority which the application of oxygen in steel production offers has led to a considerable number of new metallurgical operational methods and processes for the manufacture of steel. These are as follows (named after their inventor or licenser):

In the *Rotor-Processes:* Kaldo-Rotor (after Bo Kalling, Domnarvet/Sweden.

Graef-Rotor after R. Graef, Oberhausen.

In the *Special Top Blowing processes:*

PL Phoenix lance processes of the Phoenix-Rhein rotor A.G., Duisburg.

Converter Top Blowing processes:

LD Linz Donawitz process.

LDAC (OCP) of ARBED in Luxembourg.

OLP Oxygen, Limestone-Powder by IRSID in France. with fine powdered lime.

LDP according to the Krupp research, Essen.

The best known is the Linz Donawitz (LD) process. Here technically pure oxygen (99·5 to 99·8 per cent) is blown vertically from above through a water cooled nozzle or lance at 6 to 15 atmospheres absolute pressure on to the molten charge. Through oxidation of the pig iron impurities which are partially *vaporized* (C to CO, Mn and Fe) this refining process results in the production of liquid steel. Today in over fifty converters throughout the world a yearly output of 20 million tons of ingot steel is achieved. Over forty more LD—steel blowing plants are either under construction or in the process of being designed.

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* Verein Deutscher Eisenhüttenleute, Düsseldorf.

With some justification " brown smoke " has occupied a special position in dust technology, which already speaks for itself by its very name. Here dust technology is faced with a completely new task, for up till now it has never been necessary on a large technical scale in the rough conditions of a steel works to separate submicroscopically small particles from an intensely hot waste gas (up to 1,800°C.) which accumulates in extremely variable quantities.

With the close co-operation of metallurgists, physicists and dust specialists an attempt has been made to find a solution to this difficult problem.

The brown colour of the smoke is clearly traceable to the high ferric oxide content (Fe_2O_3).

The vapour pressure-equilibrium of the iron is steadily disturbed by the continuous addition of oxygen and the sharp increase of temperature in the metal bath; in this way the *vaporization* of the iron is accelerated by pure convection. The oxygen starts to react with the iron in accordance with temperature pressure and oxygen volume under ferrous oxide formation (FeO) (iron's lowest oxide).

The highest temperature in the metal bath resulting from the impact of oxygen is termed "reaction temperature", the level of which depends on the purity of the oxygen. In pure oxygen operation (LD steel blowing plants) the boiling point of iron is exceeded by a reaction temperature of 3,050°C. The gas (CO) is saturated on the combustion surface coming into contact with the iron vapour. All the metal phases present vaporize at a point of extremely high reaction temperature in proportion to their vapour pressure. During this process the other elements with an affinity for oxygen like Mn and P are removed.

When the blow is carried out with *hot air* minus the oxygen addition very much smaller superheats occur (max. 2,300°C.)—only 0·01 per cent Fe vaporizes, which constitutes approx. 100 g/t of iron melted, while the loss of iron on evaporating where the blow is carried out with oxygen enrichment for example amounts to 35 per cent O_2 up to 0·1 per cent Fe, *i.e.* about 1 kg/t liquid iron, corresponding to the increased superheating.

Converter fumes consists of fine grains of strikingly similar size, and which increase in size towards the end of the blow. The particle size is well under the wavelength of visible light. The particles therefore according to Rayleigh's law cause diffusion.

The converter waste gas (CO+Fe—vapour) occurs in gaseous form in the hot reaction zone and condenses, as shown above, in the cooler upper parts of the metal bath, into brown smoke during the coalescence of iron atoms into minute particles. The oxidation of these iron particles into brown smoke takes place when entrained air mixes with the waste gas above the converter mouth, since according to investigations so far made the dust immediately leaving the converter mouth contained a substantial quantity of *metallic* Fe.

Brown smoke contains on an average 65–97 per cent ferric oxide. According to most recent investigations in brown smoke from 100 t electric arc furnaces for example minute particles containing only 5 millicrons were discovered against tobacco smoke which contained 200 millicrons grain size.

According to A. Winkel the *electric and various para and ferromagnetic properties of brown smoke* are helpful in its extraction, and in any case they are not disadvantageous. However separation by purely magnetic processes, as had been recommended for the first steel blowing plant in the world (Linz) by various designers

8–10 years ago proved to be an absolute failure.

With a particle size of 30 x 30 x 10 mμ 1 g Fe_2O_3 with a specific weight of 5 has a total surface area of approx. 66m^2. This intensive colouring capacity allows *even the minutest quantities* of fine particle ferric oxide dust atoms to be clearly visible to the naked eye, for in addition to this the deflection of light and absorption exhibit a very high value. One cube of 1 mm^3 contains approx. 10^{12} particles.

In table 1 are given the operational results of one of the first dust removal plants in an LD steel blowing works, which were equipped with a dry electro filter. The total cost of this plant which possesses a waste heat boiler for the cooling of very hot brown smoke, amounted to 15·7 million DM.

Also the first two and up till now the only two German LD steel works in the Ruhr district were fitted out with very valuable and expensive wet dust removal equipment, based on experimental experience gained in Austria and U.S.A. These concerns were:

Bochumer Verein with the Pease Anthony Venturi scrubbers. The plant expenditure totalled 3·8 million DM. for two 35 t LD convertors, *Witten crucible steel works* with the Kleinst Venturi wet cyclones (installed also at the Linz steel works). These plants too employ built in waste heat boilers for the cooling of flue gases, since this presents a more effective solution than cooling by entrained air or water injection, when the volume of waste gas can exceed 800,000 m^3/h and over.

In these dust removal plants decolorization of the brown smoke is effected, which corresponds to a dust separation of 150 mg/Nm^3.

In the Mannesmann steel works in Huckingen a *bottom blown 40 t Thomas converter* of conventional design employing oxygen lance* is operated. Owing to the enormous quantities of waste gas (up to 800,000 m^3/h) expended, costly preliminary tests lasting several years had to be carried out on wet scrubbers, cyclones, etc., dry filters for trying out new dust removal processes and ones already known; (not all however proved satisfactory) all this had to be done before a large plant with an electro filter of the Lurgi design was set up in Luxembourg in 1958 as a joint plant of the " Air Refining Community of the German Thomas steel works " with financial assistance from the " high authorities " of the Mining Union (Montan Union).

In front of the filter plant a waste heat boiler had to be erected, which was adequate to deal with the hot waste gases (touching 2,000°C.) especially the extremely variable temperatures and large slag discharge. Today the technical problem of dust removal in this plant can be regarded as solved. However it should be noted in principle that this Huckingen model cannot simply be transferred to other (older) or larger converters or steel works, so that up till now an economic solution for bottom blown basic converters has not been found.

The future belongs to the top blown steel plants, which operate on the LD or similar processes. Top blown steel plants already exist in several areas, but it seems that basic steel plants (Thomas works) are hardly built now. Whether in these circumstances large building sums are to be invested in dust removal installations for basic converters which in a few years will probably only be employed in a minority of steel works and which apart from this require a good deal of space, is a serious question. To equip 80 German basic converters with dust removal plants would require some 200 to 300 million DM. Since wet dust removal gives rise to a considerable quantity of sludge (water) which according to the new ruling on water issued by the German authorities must be subjected to washing and purification, a fair amount of additional expenditure is incurred.

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* Basic (Bessemer) converter (*Translator*) Dictionary interpretation.

TABLE I

Operational results of dry Lurtgi
Electro dust removal in Donawitz

Oxygen converter with 33 t pig iron: Blowing zinc: 20 minutes;
Waste gas volume: approx. 50,000 Nm^3/h
Dust accumulation: 350 kg/melt=1·09%, relative to t- steel yield
Dust content in gas:

Entry. Electro filter	11·7 g/m^3
Exit. flue	0·014g/m^3
flue exhaust	0·407 kg/melt
Effective cleaning	99·88%

Current consumption:

	kWh/t steel	kWh/1,000 Nm^3tr
Electro filter	0·23	0·40
Total plant (including blowing installation	0·62	1·20

Water consumption: approx. 1,500 kg/melt

The attempt to produce a still quicker and more intensive reaction between the metal bath and slag led to the *Rotor-process*, where two water cooled oxygen lances are led from one side into a revolving container (as for example in the one employed by Graef-Rotor) while the whole vessel turns about one revolution per minute on its longitudinal axis. The hot waste gases accumulating in an 100 t Rotor used at the Rotor steel works of the ILSED works, Peine, are led away through a pipe to a dry electro-filter plant. The waste gases (brown smoke) have a temperature of about 600°C. They are cooled down by water to 150°C. before entering the electro filter. The extracted dust is drawn out of the bins through the discharge apparatus and is stored up in sacks for further processing. The waste gases, after cleaning escape without trace of colour through the 50 m. high smoke stack.

Electric arc furnaces too, operating recently in the steel production plants are faced with the main problem of eliminating brown smoke in removing hot flue gases by suction, which for operational, technical and metallurgical reasons is a difficult task. Latterly preference has been shown in the main for simple water cooled suction flues in the furnace roof operating near the electrodes with a water cooled fume exhaust. While large quantities of entrained air are drawn in when suction hoods are used, which necessitate the installation of large and costly dust removal plants, the volume of waste gas where exhaust stacks are employed is much less. Meanwhile several dust removal plants have been put into operation in the German Federal Republic for the elimination of brown smoke, employing either Pease Anthony Venturi scrubbers, or alternatively wet or dry electro filters.

The introduction of oxygen into the OH (open hearth) furnace* as well, for increased production has special significance and has led to its application on a large technical scale. While oxygen had mainly been employed in the first place for the enrichment of the furnace combustion air and in this way helped to curtail the melting down time, it was later used also for blowing on or into the metal bath thereby effecting an immediate refining process. In the majority of cases oxygen is introduced through water cooled lances, which are inserted through the roof, ports or rear wall.

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* Siemens Martin Open Hearth furnace (*Translator*).

The addition of oxygen in the burners or by means of the lance entails a considerable increase in flame temperature which as a consequence is expressed in increased dust formation and the emission of ferrous oxide fumes. During the reaction of the liquid pig iron under oxygen lancing the brown colouring of the fumes is noticeably intensified. For elimination of brown smoke for example in the United States in the main dry electro filters have been installed. Meanwhile here too in a 250 t OH furnace in a West German steel works several hours refining during charge to tap time has been carried out using the oxygen lance. Here for the first time in the Federal Republic a dry electro-filter for brown smoke elimination is under construction, the plant planning costs of which lie in the region of 1 million DM.

REPORT ON PROGRESS IN MEDICAL RESEARCH IN AIR POLLUTION IN THE UNITED KINGDOM

by Marjorie Clifton, M.D.[*]

Smoking and Lung Cancer

ON the subject of air pollution as a factor in disease, the most important event recently has been the publication of the Report of the Royal College of Physicians on Smoking and Lung Cancer.

Clean air is a personal as well as a community matter and each one of us can make his or her choice about personal smoke pollution without benefit of legislation. The importance of the report is independent of any argument about the mechanism by which the relationship between smoking and lung cancer may be effected.

Bronchitis: the English Disease

Some progress has been made in determining the nature of chronic bronchitis. It is now recognised as having three phases, though these are not always separate in time and may differ in emphasis in individual cases:

(1) Hypersecretion of mucus: the stage of "cough and spit";

(2) Recurrent infections;

(3) Airways obstruction with breathlessness and emphysema (a condition of ballooning of the lung tissue with loss of elasticity and thus of the contractile power which normally expels air from the chest).

The work of Lynne Reid and others has been valuable in establishing the patterns of pathology, but the definition of chronic bronchitis is still in dispute and until a standardized nomenclature is adopted, not only international comparisons but also comparisons between the results of surveys within one country are impossible.

It is, if anything, more important to be able to detect the earliest stages, when treatment might prevent chronic disability, than to count the number of breathless, blue-lipped, wheezing, choking sufferers in the final stages.

In 1960 under the auspices of the Medical Research Council, a detailed questionnaire on bronchitis symptoms for use in field studies was compiled, and if used in accordance with the instructions this questionnaire provides a reliable basis for comparative studies. A brief or an extended version can be used. I have examples of each here if overseas delegates would like to see them and supplies can be obtained from the Medical Research Council.

Comparisons between the disease as seen in this country and in the United States show that in the U.S.A. they have less mucus secretion but much emphysema.

Epidemiology

Field studies of different kinds have of course been done in this country. The majority have been studies of the prevalence of bronchitis symptoms by the use of a questionnaire with or without simple lung function tests. These have shown that there is a strong association between smoking and the presence of cough and phlegm irrespective of whether the individual lives in town or country. Breathlessness, airways obstruction and bronchitis illnesses on the other hand are commoner in town dwellers. A comparative study has been carried out in England and Norway using the M.R.C. Questionnaire which showed that real differences do exist between the two countries.

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Prevalence studies are unsatisfactory because evidence about events in the past of the individual is usually unreliable and also the two or more populations being compared inevitably differ in many fundamental respects, so that their experience of air pollution is only one of many differences which might affect the results. Two other types of study are being used in order to avoid these difficulties.

Prospective surveys are those which undertake to watch a certain group of individuals over a considerable period, so that changes in their environmental circumstances can be related to changes in their health. Dr. Charles Fletcher of the Postgraduate Medical School in London is carrying out a pilot survey of this kind on employees of London Transport and of the General Post Office. This is a long-term project and must, alas, inevitably be somewhat wasteful, since only a small proportion of those studied will develop chest disease. The first analysis of data is now being carried out.

The study of day-to-day changes in health and in the concentrations of air pollutants in a given area has the advantages that the same population is at risk and no elaborate system of controls is required. This type of study is being carried out in London by the Medical Officers of Health of the Metropolitan Boroughs in collaboration with the College of General Practitioners, the London County Council and the Ministry of Health. Sickness will be studied from records of consultations given by family doctors, and from hospital admissions via the Emergency Bed Service. Death certificates will be analysed, and records of daily concentrations of smoke and sulphur dioxide will be used (these are now measured all over London) together with special hourly smoke measurements when fog is forecast. In this way the build-up of pollution can be related to changes in the statistics of sickness and death in Metropolitan London, to reinforce knowledge gained from previous surveys of a similar kind elsewhere.

A very useful publication has recently been issued which summarizes all aspects of the subject. It is No. 15 in the World Health Organisation's Series "Public Health Reports" entitled "Epidemiology of Air Pollution: Report on a Symposium", by Drs. Lawther, Martin and Wilkins (1962) and costs 1s. 9d. from H.M. Stationery Office or from W.H.O. in Geneva.

Identification of the Harmful Components of Pollution

Any discussion of this sort inevitably leads us to the great need for identification of the components of air pollution which are responsible for its harmful effects. Ordinary measurements can only provide an index of the rise and fall of pollution; its true nature is extremely complex, both chemically and physically.

The Medical Research Council Unit at St. Bartholomew's Hospital has been working in this field. A paper on "Electron microscopy of urban atmospheres" by Waller, Cartwright and Brooks is shortly to be published, and other work is in progress on the detection of microscopic amounts of sulphuric acid and on the display of acid droplets by microscopic means. In addition, a hand model transistorized SO_2 recorder for spot tests is being developed.

The effects of particular pollutants have been studied at the M.R.C. Unit and by the Pneumoconiosis Research Unit where an interesting series of experiments on human volunteers showed that the inhalation of concentrated inert dust particles of a certain size resulted in increased airways resistance. The M.R.C. Unit is studying the effect of acid droplets. Both units have worked on the variability in airways resistance in individual volunteers and over two years at the M.R.C. Unit this has been shown to be changeable and unpredictable to an unexpected degree.

At Warren Spring Laboratory of

D.S.I.R. we are making very satisfactory progress in the organization of our National Survey of Smoke and Sulphur Dioxide, with the number of daily sampling sites approaching 900. The Laboratory is collaborating in the London survey of pollution and health, and we will gladly help in any similar surveys which may be planned.

Work continues on instrument development, on surveys dealing with special local problems, on studies of chimney plumes and diesel exhausts, and on methods of removing sulphur from flue gases.

This country seems determined to reduce aerial smoke pollution and to discourage smoking among young people, and United Kingdom research workers believe that not only national but international co-operation is essential to an understanding of the complexities of pollution and its effect on health. The fact that "no satisfactory morbidity statistics appear to exist in any European country" (and here I quote from the W.H.O. Public Health Report No. 15) deserves very serious consideration, and I believe this is true of America too. It would be a great step forward if the standardization of sampling techniques which is now being urged by O.E.C.D. could be matched by standardization in the measurement of some indices of damage to health.

NORTHERN IRELAND

by W. E. C. O'Brien, M.R.S.H., M.A.P.H.I.[*]

NORTHERN IRELAND comprises an area of 5,242 square miles and the population numbers 1,425,000. Sixty per cent of the population live in urban areas and the remaining 40 per cent live in rural areas. The capital city, Belfast, has a population of 416,000 and the combined population of Belfast and its environs is about 572,000 or about two-fifths of the total population.

The principal industries are agriculture, textile production, shipbuilding, engineering, manufacture of ropes and twines, tobacco, clothing and food products. In recent years there has been a considerable industrial expansion. A large number of new factories has been erected and many more are either building or planned. Since the end of the war over 100,000 new houses have been built.

All industrial and domestic coal supplies including solid smokeless fuels are imported from Great Britain. This involves additional transport and handling charges and the retail selling prices of all solid fuels are consequently higher than those obtaining in Great Britain.

There is of course an air pollution problem, about which little or nothing is being done. The nature and extent of the pollution varies a good deal. In a number of districts air pollution is very serious and gives rise to conditions which constitute a public health hazard. Meantime a number of local authorities are recording daily measurements of the smoke and sulphur dioxide in the atmosphere and in some areas the amount of deposited matter is being ascertained and recorded.

There is no legislation in Northern Ireland similar to the English Clean Air Act of 1956. The existing legislation, which deals rather loosely with smoke emission from factory chimneys, dates back to 1878, and is rather weak and ineffective. No law exists to control the emission of smoke from domestic chimneys.

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However it is understood the Government is now considering the question of clean air legislation and we await with interest the statement the Minister of Health and Local Government has promised to make to Parliament.

Legislation in Northern Ireland is usually similar to that obtaining in England. Often a "step by step" policy is followed and we hope in this vital matter of clean air the Government will introduce legislation similar in purpose to the 1956 Clean Air Act.

In March of this year, the Northern Ireland Division of the National Society was formed and the aims and objects of the Society are now being promoted in Northern Ireland. Our immediate task, as a Division, must be to arouse interest and by the effective use of suitable means of propaganda and publicity bring home to our people the evil effects of air pollution and at the same time create a public demand for clean air and a sense of urgency.

With all this in mind the Division has arranged for a public meeting to take place in Belfast early in December at which a symposium of papers will be presented and a number of Clean Air exhibits displayed.

We have, in Northern Ireland, a long way to travel before the objective of Clean Air is achieved. There will no doubt be many difficulties to overcome in resolving our air pollution problem, but in co-operation with Government Departments, Local Authorities and other interested bodies we are not without hope that the day will come when air pollution, with its evil effects, will be brought under control and our people will be able to breathe clean air, which surely is the birthright of people everywhere and which we know is so essential to good health and human well being.

Discussion

Dr. P. E. Joosting, as an addendum to his paper, writes:

The air pollution data demonstrate a non-negligible seasonal, daily and hourly swing, but this is between narrow limits. Moreover the spread of pollution over the area of Geleen tends to be more or less homogeneous. This is the more remarkable, because public opinion would not have confirmed this finding. Only a a little part represents occasionally moderately high values of pollution, but without hazard as must be concluded from the medical data. This underlines the important role scientific research can play in the formulation of the right and real arguments on behalf of the growing awareness that air pollution is an evil thing.

If one fails to demonstrate a statistical correlation between pollution data and health patterns using the above criterion, it is not right to exclude any harm or hazard. It might be possible to demonstrate patho-physiologic responses under the population nearest to the chemical plants. But what is the real meaning of such findings? Where is the borderline between health and infirmity? What imbalance in the physiological systems of living beings are tolerable before falling sick? And which should be prevented definitely? Here lies the trap for the medical and scientific professions. If doctors fail to demonstrate the disabling influence of air pollution with publicly accepted arguments like vital statistics, absenteeism figures, emergency bed service and other reflections of the benefits of modern civilization, the other party can say: so what!

This relativity calls for new arguments. To generalize: what we all prefer and are likely to pursue is clean air, in the same way as we like a glass of crystal-clear water instead of sterilized harmless peat-swamp dregs, which we refuse to drink under civilized conditions. Although we need only little for ingestion and personal use, we want all water for domestic use to be pure. For that reason we all together pay for the purification of millions of gallons every day.

In the same way it is important to promote the idea of clean air among all concerned before, and along with, enacting laws and rules. T.N.O. stimulates in various parts of the Netherlands the formation of regional contact groups, in which industry, local authority, science and other representatives meet and find each other. By exchange of thoughts grows a common sense and then ambition can turn up in a new garb: as competition between rivals in reducing their own part in the mass of air pollution.

In the Netherlands a so called Nuisance Act exists and this year a new inspectorate for environmental hygiene has been created in order to deal with sanitary problems like air pollution.

But so long as there is a gap between the attitude of people concerned and governmental activities by law and act, T.N.O. believes in stimulation along informal channels like contact groups and round table discussions.

To repeat the words of Pelletier, the French fighter for clean air, reciting Quevauviller: "We must promote by human contact the mystic idea of clean air among those responsible without evoking the psychosis of dirty air amongst those who can't help."

J. P. Detrie (Centre Interprofessionnel Technique d'Études de la Pollution Atmosphérique, France), thanked the Chairman for giving him an opportunity to speak on the French Clean Air Organization, thus completing the report already given by M. Levantal on the French Organization against atmospheric pollution and the part played by L'Association pour la Prévention de la Pollution Atmosphérique (Association for averting Atmospheric Pollution). He hoped to explain the work done by public health inspectors in detecting pollution and the work of public education undertaken by his organization.

Following the initiative of the Institut Français des Combustibles et de l'Énergie (French Fuel and Energy Institute) representatives from French industry had met together and studied the technical and economic methods of countering atmospheric pollution. In September 1960 the Comité d'Action Technique contre la Pollution Atmosphérique (Technical Action Committee against Atmospheric Pollution) was established under the presidency of M. Louis Armand, well-known for his services to clean air in France.

At the outset the work of the Committee was clearly stated by the French Minister of Public Health, M. Chenot—"the Association for averting Atmospheric Pollution and the Public Health Inspectors had a duty to diagnose and estimate the dangers of atmospheric pollution". The Technical Action Committee against Atmospheric Pollution would propound the remedies for countering atmospheric pollution. Hence they were the counsellor to the government when legislation was framed and their help could ensure that such legislation was both technically and economically feasible.

Their committee, M. Detrie said, recognised its responsibilities and placed two proposals before the Government. The first dealt with clean air in general, the second was related to home-heating. Explanatory comment submitted with these proposals had enabled the Government to frame legislation which had resulted in the Clean Air Act of August, 1961. In addition to fulfilling its part on a legislative level the committee had stressed the need to complete numerous technical and scientific studies; as a result a "Centre Interprofessionnel Technique d'Études de la Pollution Atmosphérique" (Interprofessional Centre for Studies on Atmospheric Pollution) had been established to undertake research which in the past, had been carried out by laboratories or research centres. With subsidies from the whole of industry but more especially by fuel dealers, oil companies and the French collieries the programme was extending from statistical studies to embrace the whole problem of smoke abatement—establishing the correct height for industrial chimneys, engaging in studies related to boilers and the problems connected with dust and gas cleaning systems, etc. The Committee's Study Centre would spend 1,500,000 francs on these activities in 1962.

M. Detrie drew attention to his Committee's concentration on pollution from domestic fires and industrial activity and then explained that another organization: "Comité d'Action pour l'Amélioration de la Carburation" (Action Committee for Carburization Improvement) had been created in 1961 to deal with the problem of pollution from road vehicles. M. Galliene was the first president.

Dr. A. E. Martin (Ministry of Health), referred to the international conferences and meetings arranged by W.H.O., the Council of Europe and many other organizations. The pattern of air pollution, he said, was found to differ from one country to another and each country had its own special lines of investigation. Specific problems of air pollution from industrial sources had been investigated in many countries and had resulted in legislation directed towards its control. The U.S.A. had its own problems from petrol fumes particularly in Los Angeles. In the United Kingdom more attention had been directed towards research on the effects of diesel fumes. Recently the importance of carbon monoxide in congested streets had been realised and research was being carried out in the U.S.A., in France and in the United Kingdom.

The patterns of pollution by atmospheric smoke varied greatly between countries, much depending on types of fuel and on the differing ways of life of the peoples. The 1960 Copenhagen Symposium organized by W.H.O. had stressed the need for international standardization of air pollution measurements. Epidemiological investigations on the effects of atmospheric pollution were frequently only practicable in large cities but similar effects undoubtedly occurred in smaller centres of population. International studies would show the need for greater means of control in many areas where the effects of pollution were at present not realized.

P. C. G. Isaac (King's College, Newcastle-upon-Tyne), congratulated the Society on organizing an international session, a fore-taste of which they had in 1959. It had been emphasized that air pollution was not a problem in which any nation had either the monopoly of the problems or their solutions. He thought that this was particularly the case with the question of morbidity data. They could only obtain, he thought, valid statistics on the effects of air pollution with the possibility of relating them to the causative factors if they had sufficiently large samples, and at least one way of extending the sample was in fact to take people from other countries.

Mr. Isaac wished to emphasize the point he had made at the Diamond Jubilee Conference in 1959. The Society was quite the oldest society of its kind in the world, and in this country had done, with its very exiguous budget, a great deal of work, which Dr. Burn had highlighted with the last report from Dr. Stern. However we could all extend the value of our work by sharing it with other people and by seeing the kind of things they had discovered, the kind of things they were trying to do, in relation to the experiences of other people. There were at least four issues they were concerned with when they came to the conference. The first of these was the question of the medical effects—what ill-health does air pollution cause? The second, becoming increasingly important, was what are the chemical factors causing these effects? And then what we were really concerned with were two sides of control: the engineering or technical aspects of control and—since after all, all useful control is essentially a matter of politics in the wider or Greek sense—we were concerned with the administrative and legislative matters.

None of these were factors or problems that were our sole concern, we could share our experiences and our solutions. It was illuminating, said Mr. Isaac, to those who were concerned with the research in this or another field, to discover ideas which, while not immediately bearing on their problem, could very soon be applied and perhaps avoid for them a whole year of rather fruitless research. So he did feel strongly that there was a case for an international association, and he would like to see the Society reversing the process which was at that time giving so much difficulty to those meeting in Llandudno, and invite their European colleagues to join them in an international association for clean air.

I. Lewis (Pontardawe), referred to the publication of Public Health Studies No. 15, a symposium of air pollution problems in the European area issued by the World Health Organization. It was, he said, a document of the utmost significance. He reminded the Conference that the Session Chairman had been one of the three United Kingdom representatives in Copenhagen whose views he commended to all working in the field of air pollution and public health. They summarized present day knowledge on the significant relationships between ill-health and air pollution and stressed the need for standardization of practice and diagnosis.

The second point raised by Mr. Lewis dealt with vehicle pollution as it affected the driver. He considered that car heating systems heightened the dangers that already existed as a result of ground level pollution on our crowded roads. Heater intakes situated at ground level behind the radiator grilles acted as scoops, thus intensifying the concentration of pollutants in car interiors; hence the pleasant smell of wood smoke encountered on an autumn evening.

This indicated the path by which more insidious but less odourous substances could gain access. Mr. Lewis then suggested that those in a position to experiment under controlled conditions might investigate and compare pollution levels in test vehicles with and without heaters.

Authors' Replies

Dr. P. E. Joosting (Organization for Health Research T.N.O., The Netherlands), said that in the same way as we like a glass of crystal clear water, purified daily at the public expense so ultimately we would realise that we prefer living in a clean atmosphere, paid for by money at present expended on the luxury of polluted air, with its resultant damage to property and the health of the people. Commonsense and awakened public concern would achieve this victory.

He went on to quote Plato's contention that ideas dwell unconscious in the human mind and are only brought to fulfilment by a balanced awareness of good and right and went on to quote Russell's statement that all aspects of a thing are real whereas the thing itself is a mere logical construction.

He concluded by describing the human will as a vector, a force with magnitude and direction, and reminded the audience of Teilhard de Chardin's assertion that "The only discovery worth our effort is to construct the future".

M. Levantal (General Delegate of the French Association pour la Prévention de la Pollution Atmosphérique), spoke about the European Conference on air pollution planned to take place in Strasbourg in 1963. This conference, he said, would deal with such aspects of the problem as the standardization of measuring and other instruments, the influence of pollution on human health and its effects on animal and plant life, the economic implications and also scientific methods to reduce air pollution.

Monsieur Levantal referred to the eventual establishment of an International Organization for Clean Air and emphasized that the quickest and best way of achieving this goal was by the strengthening of contacts with such organizations as the National Society for Clean Air.

THE 1958 ALKALI ORDER PROCESSES

*by J. S. Carter, C.B.E.**

ONE of the recommendations in the report of the Committee on Air Pollution (Cmd. 9322) was that control of emissions from certain processes where it was known that prevention of air pollution due to smoke, grit and dust presented technical difficulties be entrusted to the alkali inspectorate of the Ministry of Housing and Local Government. Initial powers were included in the Clean Air Act, 1956, Section 17[1] of which made " smoke, grit and dust " a listed " noxious or offensive gas " under Section 27 of the Alkali, &c., Works Regulation Act, 1906. The second and greater step was the coming into effect of the Alkali, &c., Works Order, 1958, giving wide powers of control to the alkali inspectorate in a field where the emissions were not the traditional escapes from the chemical and allied industries, but smoke, grit and dust.

Since this was the first time that such problems were to be tackled on a national scale I felt that there should be a continuing record of the broad administrative and technical approach and of the successes and of the reverses, neither stressing the one nor minimizing the other. To this end in the published annual reports of the chief alkali inspector from 1958 onwards I have given factual progress reports on these newly added processes. My aim is that these reports shall be of guidance and help to students and research workers in years to come. They are a factual record of our stewardship and the alkali inspectorate are prepared to be judged on them.

I propose now briefly to review the generalities of the problems when taken over and then attempt to peer into the future to see what the position is likely to be in a few years' time.

Iron and Steel

The iron and steel industry presented the most difficult of all the chemical engineering problems. The alkali inspectorate assumed responsibility for emissions at a time when fundamental changes were beginning to occur within the industry. It had become generally accepted, but not widely put into practice, that there was need for pretreatment of ores by drying or sintering before feeding them to the blast furnace. The classical open-hearth process still dominated the steel industry, but was being challenged by the newer, pneumatic processes involving the use of oxygen in tonnages undreamed of a few years previously and by its younger rival the electric arc furnace. On the iron founding side the newer hot blast technique was challenging the traditional cold blast cupola.

All of these presented problems in a wide and expanding field and one where existing information and experience were somewhat inadequate and, moreover, one where firm major decisions had quickly to be made. Such decisions were made and have been and are being put into practice. By and large these decisions were sound and there is no reason to be dissatisfied with the rate of progress in the installation of the necessary plant. There are still difficulties, which I make no attempt to conceal, but it would seem that we in this country are on the way to having an iron and steel industry which, both from the viewpoints of technical efficiency and in the means taken to reduce air pollution to the practicable minimum will stand comparison with that of any country in the world. At this stage I acknowledge the progress made as a result of co-operation between industry and the local authorities on the elimination of smoke from the many iron and steel processes which are outside the scope of the Alkali Act.

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* Chief Alkali Inspector, Ministry of Housing and Local Government.

Looking a few years ahead we can take it that clamp calcination of ironstone, a technique specially prone to dust emissions, and which is still operated but on a steadily decreasing scale will have almost disappeared. All plants for ore drying will be adequately de-dusted. Most of the ore fed to blast furnaces will be sintered in plants provided with adequate de-dusting units and with chimneys of height appropriate to the sulphur dioxide emission. Bleeding of uncleaned gases from blast furnaces will cease.

As to steel making the great days of the classical open-hearth process will have gone for ever. Most big works will operate pneumatic processes based on tonnage oxygen. Production types will be Ajax, Kaldo, L-D, Rotor or conventional plants such as open-hearth and electric arc furnaces lanced with oxygen. Details will naturally vary from one works to another. Some will convert molten iron from the blast furnace direct to steel in one operation. Others will operate a two-stage process *i.e.* partial pre-refining by lancing the molten iron with oxygen followed by the completion of the refining in conventional plant. Where the raw material is largely cold metal or steel scrap the route will be to an increasing extent via arc furnaces. Electric arc furnaces will get bigger with possibly 80 to 100 ton furnaces as routine production units for bulk steel.

Pneumatic processes give rise to copious emission of brown fumes and the necessary fume arrestment plant will be bag filtration, electrical precipitation or high efficiency scrubbers to reduce the fume load in the exit gases to 0·05 grain per cu. ft. This is a severe requirement and one about the threshold of visibility, but it is one which can be attained and is being attained.

The most intractable problem and one where no complete solution is yet in sight concerns emissions from bottom-blown Bessemer convertors. Here the problem is more one of containment of the emission than one of treatment. There are such convertors at five works, some of which are likely to cease when modern pneumatic processes are installed. The future of others is uncertain.

Steel and Iron Founding

The steel founding industry has its own problems. The total amount of steel involved is small, but some half million tons yearly compared with about 20 million tons yearly of crude steel production. The main units involved are small electric arc furnaces from 1 to 15 tons capacity, most of which use or will use oxygen at some time or other in the process. Despite their small size there seems no option but to ask them to install the necessary fume plant to obtain the 0·05 grain per cu. ft. limit. Indeed many are in process of so doing. The fume plant is, of course, much smaller. Some of the plants are in well populated areas and the copious emission of brown fume when being lanced with oxygen can cause serious adverse comment.

The least tractable problem of the steel founding industry is that of the Tropenas convertor, which is essentially a small side-blown Bessemer convertor and the problem is largely similar. Before World War II more than half of the steel for castings was produced by this method. The amount is now somewhere between five and ten per cent. The decline is likely to continue as manufacturers change over to electric arc melting. Yet so long as any Tropenas convertor continues to operate there is always the likelihood of public complaint.

Turning to the iron founding industry the main emission problem is that of hot blast cupola. We have agreed with industry on provisional means (arrestment of particulate matter followed by discharge of fume at a height determined by the scale of operations) and in some cases chimneys of 200 ft. or more will be built.

However, some managements have felt these means unlikely in their particular cases to remove all ground for justified complaint and are attempting full fume treatment *e.g.* electrical precipitation, wet washing or bag filtration. The whole matter and especially as concerns the large units is at present being considered by a working party of the industry and the alkali inspectorate.

An interesting iron problem is that of the so-called air furnace used for iron roll casting. The furnace is horizontal with a moveable roof so that scrap rolls, which vary in size from a few hundredweights to some tons can be dealt with. Furnaces vary in size from 15 to 30 tons capacity. Fuel used for melting is usually pulverized coal. At the beginning of each melt there is incomplete combustion of the fuel when it comes into contact with the large lumps of cold iron. A somewhat similar problem is presented by the smaller rotary furnaces of 1 to 12 tons capacity fired by pulverized coal or oil. Here then is the added complication that such furnaces use a good deal of steel scrap which needs recarburizing and methods of recarburization add to the difficulties of dark smoke emission. Complete elimination of dark smoke is not possible and the task is to ensure that the emission is reduced to the lowest amount practicable.

Copper and Aluminium

As to the two non-ferrous metals, copper and aluminium, the tonnages are but a few per cent. of that for steel production and the national problem is therefore smaller.

Experience with copper works has shown that the registrable processes give rise to rather less emission than do preliminary and ancillary operations such as melting of swarf or blowing to remove zinc. Moreover, there are hazards due to emissions of arsenic, cadmium, phosphorus, etc. not always covered by the definition, which was based solely on smoke emission. It is now proposed to amend the definitions so that the alkali inspectorate can concentrate on the problems of metallurgical fume and on the emission of smoke from the large works, with care of smoke emissions from the casting operations at smaller works restored to the officers of the local authority. The smoke emission problems of the very large works can be serious and despite much research and pilot scale trials no generally applicable solution has yet been found. There are, however, no grounds for pessimism.

Concerning aluminium there is no primary smelting in England and Wales, only the secondary smelting of aluminium *e.g.* recovery from scrap usually by melting with common salt as a flux. The smoke problems are essentially those resulting from use of contaminated scrap and the fume emission problem is largely that of salt fume together with some emission of fluorine compounds from the flux used. The task, therefore, is one of routine chemical engineering, and likely to be solved by application of electrical precipitation or high duty wet washers.

Power Stations

The generation of electric power is an expanding industry. The total generation capacity has more than doubled in the past ten years and as a result of concentration at more powerful stations the total number of power stations has fallen by about one-third. In 1961 a total of some 60 million tons of coal equivalent were burned in power stations in England and Wales and a total of 100 million tons coal equivalent may be reached by 1970, possibly burned at about half the present number of power stations. The new power stations ranging up to 4,000 MW will be fitted with very high efficiency grit arrestment plant and with chimneys of 600 to 650 feet. The dominant problem here is that of adequate dispersal of sulphur oxides. The geographical pattern of electricity consumption is vastly different from that of coal production. The southern half of the country produces little coal yet consumes nearly half of the electricity generated. There are also coal deficiencies in parts of the north-west. The crucial question is whether coal should be moved to the deficient areas or whether electricity should be transmitted. A partial answer is possible by siting oil-fired and nuclear power stations in the coal deficient areas. Siting of oil-fired stations is, however, determined in large degree by proximity to major oil terminals and refineries.

It is somewhat ironical after speaking of these huge new power stations to state that the power stations most productive of complaint are the very small stations (pygmy by modern standards) which present a problem out of all proportion to their size. Nearly all of them date from a time when standards of grit arrestment, etc. were lower than those acceptable to-day. However, the recent almost dramatic upsurge in demand for electricity has required their short-term operation, usually in periods of cold weather. Although their power generation is to be recorded in days yearly rather than in weeks, nonetheless they draw severe adverse attention to themselves when operating. It was the view of the Committee on Air Pollution (Cmd. 9322), and one which I had regarded almost as an instruction, that such power stations should cease to operate by 1964. The Central Electricity Generating Board have indeed collaborated and some 70 stations with a total capacity of about 800 MW have been closed over the past few years. Demand for electricity is, however, such that it is necessary to retain in service some of these small old generating plants to assist in meeting peak demands especially over the difficult period 1963/66. We shall do all that is practicable to ensure that emissions therefrom are kept to a minimum and are in close touch with the Board on this facet.

Gas

The importance of producer gas in industry continues to decline. About a third of the plants which were registered in 1958 have already ceased to operate and the number is likely further to fall. The present tendency is to go over to other methods of firing *e.g.* oil, especially as plant becomes due for overhaul or replacement. Nonetheless, there still remains plant with useful life before it and likely to be used for some years to come. In collaboration with the industries concerned we are getting out a code of practice so that during this final period smoke emissions can be kept as low as possible. The major problem here is that of dark smoke emissions on " burning-out " of mains.

As to the gas industry, concentration of operations continues, there being now operative but one-third of the number of works of a few years back and even under these conditions about one-quarter of the works operating produce three-quarters of the gas made. As will be appreciated concentration at fewer and larger works aggravates some problems. On the other hand larger works usually have better facilities for technical control and a greater proportion of modern plant. The gas industry is indeed one which is at the crossroads. It is the view of many in the industry that the last conventional coal carbonization plant has been built and that the industry's future lies in processes for the complete gasification of coal by Lurgi and related techniques and by gasification and reforming processes based on liquid and gaseous products of petroleum refining.

It is unnecessary to remind a gathering drawn appreciably from the industrial north of the many and serious emission problems of the coke oven industry. They are reviewed at length in the 97th alkali report for 1960 and it must here suffice to say that so long as coke ovens exist they will present one of the most formidable tasks facing the alkali inspectorate.

Ceramic Processes

Numerically the largest class of works added by the Order of 1958 came from the ceramic industry. Save for certain special products *e.g.* Staffordshire blue bricks, taking a long term view, the ceramic industry must eventually become largely smokeless by normal processes of technical evolution. This is, however, looking quite a few years ahead.

Progress is most rapid in the pottery industry where at one time the smoke from the old fashioned traditional bottle ovens produced a pall over Stoke-on-Trent. These are steadily disappearing and are being replaced by smokeless methods of firing which are, of course, under the control of officers of the local authority under the Clean Air Act. In 1938 there were some 2,000 coal fired operable bottle ovens in the Stoke-on-Trent area. When the Alkali Order became operative in June, 1958 there were 295. By December, 1959 the number was 222, by December, 1960, 157 and by December, 1961, it had fallen to 95. The direct interest of the alkali inspectorate in smoke from the pottery industry is thus rapidly reaching vanishing point.

Three special sections of the heavy clay industry, blue engineering bricks, salt-glazing of earthenware and Fletton bricks, all largely localized in a few areas, have their own special emission problems. The blue engineering brick problem is that of dark smoke, the blackness of which has to be seen to be believed; the salt-glazing emission is essentially that of acid fumes combined with a copious white salt emission, and the Fletton emission is that of an offensive smell with an emission of fluorine compounds which gives rise to an agricultural hazard. These problems are discussed at some length in the published alkali reports.

If firing is carried out in continuous kilns, and especially in top-fired continuous kilns, there is little or no serious problem of smoke emission. Indeed four-fifths of the output of building bricks is already fired in continuous kilns with in general but little smoke production. This may well be the ultimate solution although some intermittent kilns may have to be retained for certain special products. Meantime the national smoke problem relates mainly to the 3,000 or so intermittent kilns. These are mostly small and with chimney heights which are inadequate. At the moment but one-fifth of these kilns are fitted with mechanical stoking or oil firing. Some form of continuous firing is probably essential if smoke is to be reduced to the minimum. The problem is however less simple than might appear at first sight. It is not solely a combustion problem and the desiderata for boiler firing do not necessarily apply. There is much ceramic technique to be considered. Similar kilns may be doing different jobs ceramically and the wastage factor in production must be watched. Products are many and diverse, with art, science and trade habits closely interwoven. Quality of a particular product is almost sacrosanct. Nonetheless, conditions cannot be allowed to remain as they are.

Lime Works

The remaining processes added to the Schedule by the 1958 Order are relatively few. As to lime works, this is a small industry the national coal consumption being but that of a single medium-sized power station. Complaint on the score of dark smoke is justified and appreciable. The real problem concerns the coal-fired shaft kilns in the northern half of the country which produce the high quality limes which certain industries demand. The technical problem is that of trying to burn coal smokelessly in an atmosphere largely of carbon dioxide and nitrogen. The economic problem is that lime is probably the lowest priced of the basic chemicals. The task is indeed difficult but there are no grounds yet for writing it off as hopeless. Other qualities of lime are produced elsewhere by processes which are virtually smokeless using coke or blast furnace gas as fuel and which are the concern of the local authority.

The remaining processes, sulphate reduction, caustic soda and chemical incineration, together involve a mere dozen works and are therefore of but local interest only.

Although there are still technical pockets of resistance to be overcome *e.g.* the Bessemer converter and the blue brick industry smoke, and although certain older plants, notably some sinter units and some of the smaller electric power stations, leave a good deal to be desired, nonetheless, there are good and reasonable hopes that the next few years will see the solution of most of our industrial pollution problems due to smoke, grit and dust, and that presumably this will be the first country where this has been achieved.

Discussion

Dr. J. S. G. Burnett (Preston), expressed his pleasure at being able to record publicly the Society's appreciation of the work of the Alkali Inspectorate in the field of air pollution since the coming into operation of the 1958 Order.

The Iron and Steel Industry in particular was one which was in the throes of technical development with related new pollution problems and the manner of their handling in the light of the immense economic and technical issue involved were very much to Dr. Carter's credit.

On power stations it was appreciated that the terrific demand for electricity had been responsible for the delay in closing down old inefficient plant and if they had to continue in use for some years yet, the answer to the dust and gaseous pollution might well lie in their conversion to the burning of low sulphur content fuel oil. As to the huge new power stations with their 600 feet chimneys this was certainly a practical contribution to a difficult problem but many people would feel happier if one or other of the new German processes for cleaning sulphur from flue gas were shown to be a successful proposition.

Dr. Carter's reference to the amount of smoke associated with the production of blue bricks led the speaker to suggest that tradition died hard and was mainly responsible for the trouble in this field. Were there not other bricks possessing the same qualities as the blue brick already available or easily made available and could not the consumer be persuaded by a sales campaign to change over?

Two things were abundantly clear. Firstly there was a trend of thought in the population generally towards the idea that things should be burnt smokelessly and secondly the extensive and sharp changes that were taking place in the industrial field. In the space heating of homes and in the volume and character of road usage we saw that smoke pollution was materially lessening but that new problems were appearing demanding the ceaseless vigilance of the Society.

Councillor C. A. Watson (Scunthorpe), described the paper read by the Chief Inspector as an excellent example of both clarity and candour.

He would, however, like to put three questions to him: 1. Was he satisfied that his side of the job was being done as it should be done? 2. Was he satisfied with the result being achieved by his inspectors? 3. Was he satisfied that the job could be done as it should be done with the staff at his disposal and, if not, was the obstruction caused by the Treasury?

He would like to refer to one other angle of the problem connected with the prevention of pollution at the large integrated steel works. Plant was in the main as effective as is its proper operation, particularly as it applied to ore preparation, coal carbonization, sinter making and any deliberate and designed "slipping" of the burden in blast furnaces.

If this was accepted would he advocate to managers of such departments, the appointment of pollution prevention officers who should be responsible for the supervision and training of operatives whose work if not properly performed could cause pollution?

Dr. Marjorie Clifton (Warren Spring Laboratory), said that it seemed important to stress that even when the "good neighbour" industrialist had complied with all the requirements of the Clean Air Act, and had eliminated the smoke from his factory plume, he might very well be emitting sulphur dioxide in amounts which neither he nor the public health authority recognised, and which might constitute a real danger when inversion conditions occurred.

An example of this during the Medical Research Council's survey in Sheffield had been the case of a small steelworks where a change in the melting installation had taken place. Dust precipitating equipment had taken care of the smoke, but by pure coincidence one of the M.R.C. sampling sites was within a few yards of the rather short stack, in a school yard, and it was noticed that concentrations of SO_2 were rising. The level on a normal March day was equal to that in the worst smog during the previous four years, and three times that at any other site in the city. Two thousand people lived in that district close to the factory; the area was full of smells from industry and the extra sulphur dioxide would probably not have been noticed in the absence of measurements. Industry was constantly introducing new techniques; it should not be forgotten that because a plume was invisible it was not necessarily innocuous, and very great changes in SO_2 might go undetected unless monitoring were vigilantly maintained.

G. A. Hiller (Leicester), said that he was interested to hear what the Electricity Generating Authority was planning for the future regarding large stations and noted that some very small stations had been closed. However, he was much more concerned with the intermediate stations which apparently the Board admitted were causing a great deal of trouble. He wished to emphasize the need for better maintenance and supervision as well as some capital expenditure, as there seemed no doubt that many of these stations would continue in operation for some time after residential areas round about them had become the subject of Smoke Control Orders.

The Board did not seem to be unduly concerned in this matter and he felt a much greater sense of urgency was needed.

Councillor W. A. N. Jones (Birmingham), commented on the number of people who came to Harrogate to escape from the poisoned atmosphere of our great cities and towns. In the Valley Gardens close to the Conference were sulphur and iron waters. Thirty-six springs rose within an acre which we could drink with beneficial results to our tormented bodies. However when imbibed through the nose and throat as sulphurous gases and metallic particles the reverse was the effect.

He had listened with delightful intent to Dr. Carter's paper but its able writing and charming delivery could not disguise the disturbing facts it contained—"many technical problems for the effectual extraction of grit, dust and fumes from the processes within the iron and steel industry yet remained unsolved"—"only provisional means of the treatment and arrestation methods of the air pollution problems have yet been agreed". Mr. Jones lamented the frequency of such statements in the paper and referred to Dr. Carter's excusal of both the industry and the inspectorate—"a revolutionary change of method was taking place".

He referred to the efforts of members of local authorities to promote clean air zones. They, too, felt revolutionary and said as strongly as possible that the industry and inspectorate must of urgent necessity be able to present a much better report in the next few years.

C. H. Crawford (Brierley Hill), stated that he had listened to Dr. Carter with interest and a new hope at his forecast of clean air to come. His urban district had seventeen works registered under the Alkali Acts; his council had made fourteen Smoke Control Orders, eleven of which were in operation. The Public Health Committee was quite firm in its intention to eliminate air pollution whenever it is practicable to do so. It was necessary, however, to convert the general public to this view. This meant that somehow or other public explanations must be made as to the reasons why registered processes cannot yet stop polluting the air of adjoining smokeless zones. This was the job the local councillor and public health inspector had to do, but Mr. Crawford felt that some help should come from the Alkali Inspectorate. Somehow, the gap between Whitehall and the householder must be bridged. He had excellent personal contact and relations with the Local District Alkali Inspector and had sympathy with him in regard to the size of his district, he could not be in Brierley Hill all the time.

Mr. Crawford also asked Dr. Carter whether he was satisfied that in the heavy clay industry all was being done by operators to reduce smoke to a minimum by careful firing. Would it help if the Local Public Health Inspector reported heavy emissions to the District Alkali Inspector?

B. D. Allen (Coventry), expressed the opinion that whilst many industries were prepared to use the technical knowledge available for atmospheric pollution control when there was an economic advantage to be gained, he was not entirely convinced that those industries were as willing to play their part when there was no economic advantage. He said that when the Alkali Works Order of 1958 was made some sections of industry hailed it with great delight. This was not in any way from the point of view of having to deal with a Government official rather than a local authority official but that they felt the remoteness of the alkali inspector (often one inspector has to cover a very large area with many industries) encouraged some industries to feel that the pressure had been taken off and they could go slow. Comment had been made by Dr. Carter of the great improvement in the pottery industry. This was of economic advantage to the industry and he wondered whether the same progress would have been made had no such advantages been apparent.

He questioned whether all sections of industry were playing fair with the local authorities and the alkali inspectorate.

Alderman W. L. Dingley (Warwickshire Clean Air Council), emphasized that progress depended on technical invention. It would be welcome news that the Treasury had agreed to the suggestion that substantial awards should be made each year for the best inventions for air pollution prevention.

Dr. C. F. Lynch (Dover), raised the question of better control of scheduled processes by the Alkali Inspectorate, especially in relation to gas producing plant. He referred to Dover Gas Works where operations had been concentrated causing a persistent source of nuisance to residents in the neighbourhood.

He acknowledged the help already given by the Alkali Inspectorate in eliminating some of the faults giving rise to serious nuisance but felt that there were technical difficulties still to be overcome in view of the continuance of unaccountable noxious emanations. He suggested that there was need for more frequent investigations to trace obscure causes of air pollution at the Works and hoped that the Central Authority would consider a review of the present system of inspection and control.

E. J. Winfield (Castleford), referred to Dr. Carter's point of co-operation between local authority officers and the alkali inspectors. He commended this to all concerned and referred to his own personal experience of achieving excellent results by liaison and co-operation.

In humorous terms he pointed out that the inspectors were normal human beings who were quite approachable and extremely helpful as well as being competent officials.

In the case of clean air there were many tasks to be undertaken and joint action could and did achieve improvements of great benefit to the community at large.

S. C. Beaumont (Birmingham), said he had read Dr. Carter's Paper and listened to his remarks from the platform with considerable interest. He noted that the Paper referred to the difficulty in preventing smoke from copper works and trusted that a solution to the problem would soon be found. With regard to aluminium works Dr. Carter had stated that the prevention of pollution was likely to be solved by the application of electrical precipitators or high duty wet washers. He felt that it would be more acceptable if Dr. Carter had said this problem "could be" instead of saying it was "likely to be", solved by electrical precipitation or high duty wet washers. The problem of the alkali inspectorate was appreciated, but nevertheless in the drive for clean air, he sensed a feeling of disappointment at the rate of progress made towards mitigating the pollution from many of these processes. He appreciated that in many processes the prevention of pollution will be costly and difficult to achieve, he could not imagine in this age of scientific achievement that the problem of smoke prevention was insurmountable.

J. R. Taylor (Central Electricity Generating Board), stated that the Board's approach to these problems of smoke and grit emissions was based on "good neighbour relations" and to achieve this the declared policy was that the same degree of attention shall be focused upon high standards of operation of grit arresting equipment and the control of chimney emissions as on the attainment of low capital costs and high thermal efficiency. Electricity was smokeless in use and in its generation fuels were burned as smokelessly as practicable. Special difficulties might arise however, where obsolete plant must be retained in service to meet peak loads. The desirability of using scarce capital for short term benefit for a few hours each year could be questioned, but to implement policy and so to make a maximum contribution to the clean air campaign the Board had commenced work on an intensive programme of modifications or renewals of grit arresting equipment, or to convert to oil firing obsolete plants to ensure that they achieve standards of performance more in keeping with modern practice. The cost of this work over the next two or three years would be about £11 million.

W. M. Lewis (Warwickshire Clean Air Council), stated that for the past eighteen months the Warwickshire Clean Air Council had been concerning itself with determining the level of atmospheric fluorine throughout the county. This had been accomplished by determining the monthly contamination throughout some 52 deposit gauges operated by the W.C.A.C. and sited in both rural and urban areas in the county.

An average monthly fluoride value over the past twelve months throughout the whole county was 426 milligrams per 100 square metres of exposed surface or on average an annual deposition of about five grams per 100 square metres. Minimum values in some urban locations over the year as low as two grams were recorded, and it was found in general that districts most affected by fluorine were not, as might perhaps have been anticipated, those areas subject to highest levels of conventional industrial pollution.

The gauge recording the greatest contamination yielded an annual value of 13 grams per 100 square centimetres, *i.e.* a value two and a half times in excess of the county average, and more than six times greater than the least affected area. Areas suffering the greatest pollution from fluorine were those in which aluminium works were operating; areas containing cement works were a very close second followed by an area in which ceramics are manufactured.

As fluorine was a rather toxic element possessing very irritant properties which were at least the equivalent of chlorine, what level in the atmosphere should be tolerated? If such a question was not easily answered, was it not possible to impose maximum concentration limits in the chimney effluent from those industries known to be responsible for this particular pollutant? To express fluorine in terms of sulphur dioxide, as is often done, was completely unjustified and unrealistic. The degree of toxicity compared with sulphur dioxide might be completely different. If convenient chemical methods were available for determining such elements, it was suggested that such should be used, for only by so doing could the medical profession be granted the opportunity of evaluating the incidence of respiratory disease with levels of particular pollutants in the atmosphere.

J. W. Butler (Individual Member), said that factories and works whose processes presented special technical problems as regards the prevention or control of air pollution were now confronted with tall blocks of flats. The local authorities allowed these flats to be erected almost on top of the industrial premises, thereby aggravating the industrialists' problems. Did the chief inspector consider that planning authorities gave sufficient thought to this question?

Dr. J. S. Carter, replying, thanked Dr. Burnett for his kindness. He was afraid that the solution of the problem of routine removal of sulphur oxides from power station gases lay in the future. In the meantime there was no alternative to dispersal of waste gases, adequately de-dusted and with considerable thermal buoyancy, at a very high level. Regarding blue bricks he agreed that there were bricks of other colour possessing extremely high qualities as engineering bricks also available and made by processes which gave rise to much less dark smoke emission. Not all such bricks possessed these qualities, however. On the other hand all blue bricks possessed them. The blue colour was thus a guarantee of high quality. So long as consulting engineers specified blue bricks presumably the industry must continue.

As to Councillor Watson's points he felt that the answer to his first two questions was a definite yes. With regard to the third, when the outstanding problems were more or less solved and it became a matter of routine inspection and possible frequent testing of emissions, a somewhat larger inspectorate might well be needed. He took the other points particularly regarding the designed "slipping" of the burden in blast furnaces, and would give particular attention to this facet. Many large works now employed officers whose duties were essentially those of pollution prevention officers.

As to Dr. Clifton's remarks these clearly showed the need for continued monitoring for invisible pollutants especially sulphur dioxide.

As to Mr. Hiller's remarks, the main preoccupation of the Alkali Inspectorate as regards power generation was with the medium sized stations and would likely be so for some years yet. He could not accept his remarks about the Central Electricity Generating Board.

He agreed with Councillor Jones that there were many technical problems still unsolved but felt that each succeeding year would record success in dealing with them.

He carefully noted Mr. Crawford's remarks and gave assurance that the closer relations between the local and the alkali inspectorates became the better he would be pleased. He was aware of the still unsolved problems in Brierley Hill. The matter of emissions from the heavy clay industry, in many directions largely traditional, was causing him some concern.

As to the comments made by Mr. Allen these could be true in some instances but by and large industry was playing its part and was expending large sums of money in the interests of minimization of air pollution even where there was no economic advantage to be gained. He could not accept the thesis of the remoteness of the alkali inspectorate.

As to Dr. Lynch he would arrange for the matter of emissions from Dover gasworks again to receive attention on his return from the meeting.

He thanked Mr. Winfield for his cordial remarks in that they gave him once again an opportunity to say that only by co-operation between the central and local authorities was progress possible.

He regretted that Mr. Beaumont was disappointed at the rate of progress with regard to the non-ferrous metals industry. Progress was however being made and there was a tripartite attempt by the alkali inspectorate, the industry and the British Non-Ferrous Metals Research Association to solve outstanding problems.

He thanked Mr. J. R. Taylor for his contribution and added that the inspectorate and the officials of the C.E.G.B. were in routine touch on minimization of emissions to air.

As to the remarks of Mr. Lewis, fluorine was a widely distributed element and he had as yet come across no British mineral, soil or vegetation entirely free from fluorine. So far as he was aware the national emission to air of fluorine compounds was about one per cent of that of sulphur dioxide. He believed that all deposit gauge samples in the country would show positive tests for fluorine. He agreed, however, that figures would be highest in the region of known fluorine emitters, *e.g.* certain steel works, brick works and non-ferrous metallurgical plants. Fluorine was a very reactive element and could not like chlorine exist as such in the air. Emissions were probably in particulate form as fluorine compounds. He agreed that an assessment on a national scale of fluorine pollution would be useful.

With regard to Mr. Butler's point he acknowledged the cogency of his remarks and agreed that this was indeed a matter which would demand a solution.

DOMESTIC SMOKE "QUESTIONS AND ANSWERS" SESSION

The Panel consisted of Mrs. D. M. Charlton, O.B.E., in the Chair; Mr. P. Draper, Mr. N. Hudson, M.B.E., Mr. D. N. Maddocks, Mr. W. J. S. McKinnell, Councillor Dr. M. S. Miller, J.P., Mr. R. B. Partington, Mr. F. A. Robinson and A. C. Saword

AFTER introducing the members of the Panel the Chairman read the first question: *What are the views of the Panel on grants being made in advance of smoke control areas being established, as discussed by Lord Cohen of Birkenhead in his Presidential Address?*

Dr. Miller: I feel that Lord Cohen has said something which is of very great importance to the development of the whole of this country as a smoke control area and it is my view, as I am sure it is the view of most people in the Society, that if facilities were available and grants were made to people who are willing in advance of smoke control orders being made, to fit and install appliances in their homes, there would be fewer problems to be faced and to be solved when in actual fact an order is made. I am of the very firm opinion that everything should be done by this Society and by local authorities to encourage Government action because in the last analysis it is Government action which will be needed to make grants available in advance of smoke control orders.

Mr. Saword: Lord Cohen also mentioned safeguards. I think it would be necessary for the person obtaining a grant in that way to give an undertaking that only smokeless fuels would be used in the appliance, and if such an undertaking is given, I don't think there would be a great deal of serious objection to such a proposal. I ought, however, to mention another side of the question. The Clean Air Act itself envisages smoke control areas being put forward in a nice tidy manner, like rolling out a clean new carpet. The local authority decides a year beforehand how much money it can afford for grants for conversions, it formulates its budget and considers the availability of labour for conversions, the adequacy of supplies of smokeless fuels, etc. The Government, in its turn, knows what to expect from local authorities by their programmes, and can confirm with the various fuel and appliance producing industries, whether everything will be ready at the right time. Everything keeps in step and proceeds smoothly, so when the area is established, the Inspectoral staff of the local authority are confronted with several acres of smoke control area, where anyone's smoking chimney sticks up like a sore thumb and can be easily detected and dealt with. Now if we make it a free-for-all and everybody applies for grants here, there, and everywhere, a local authority will not know in advance how much to budget for, and what to anticipate in the matter of fuel demand. And in spite of the undertakings there would be no real method of enforcement. However, weighing up this side of the question with that put forward by Lord Cohen, my own view is that allowing such conversions in advance of the orders would be of benefit in limited areas where it had been definitely decided that smoke control would come along within the next year or two. We would be taking a slight chance but on the whole I think it would be an advantage to have the public pushing forward to proceed with their conversions, rather than waiting to be dragooned into it by law.

Mr. Hudson: I think there is no doubt that this question was put because people consider it to be unfair that prior to the declaration of a smoke control order some have voluntarily contributed towards the objectives of the Clean Air Act. And personally I also think that it is unfair. I cannot see myself why the Government should not fix a date, from which time anyone who takes the steps laid down by the Act to ensure that no smoke is produced from his premises and who does that work within the provisions and the formula laid down in the Act, shall, if he reports the conversion at the time, then qualify for a grant, if at anytime in the future his area is declared a smoke control area. If this were done, it would in the first place help to expedite the change-over to smokeless conditions in certain premises, and remove the complaint that because a particular person had voluntarily complied with the Act he was penalized, while other people who had waited, got a grant at a later date. It would in addition assist some of the suppliers who encounter problems in meeting peak demands for labour to carry out conversions in a relatively short time. Each job done before that limited period helps to solve this peak problem of labour. Lastly it would mean that the local authority controlled the situation.

Chairman: Dr. Burn, who is not a member of the Panel, would like to say a word on this.

Dr. Burn: The purpose of the Clean Air Act is to bring clean air, and with that end to use smokeless fuels only. It would be most difficult to see that smokeless fuels are used if there were an indeterminate and indiscriminate number of houses, converted in different parts of the town. A point which has not been mentioned and which I would like to stress is that in my Authority, as in many others, some thousands of houses are coming into smoke control areas, last week, this week and so on. It is a great waste of staff time when, as in our case in Salford, the Health Committee are bringing in over 3,000 houses in one week. That's a very big job to do and we have not got the staff to go round, inspect and advise all these individuals in half a dozen houses. It can be done, and well done, when we do hundreds, but when we do individual houses it is most difficult and means that the operation of the Clean Air Act will be impeded.

Chairman: We may have representatives from the Ministries here, and I think it's only fair to say that this question has been before the Clean Air Council and under grave consideration by the Ministry concerned, and the reasons put forward by Dr. Burn and others were so forceful, that the Ministry could not agree at this moment to the arrangement of giving grant for a conversion that has been done prior to the order. I think I am right in saying that this has been turned down but if the Society feels strongly about it, of course they could always come back again and make another approach to the Ministry. Now we must go on to the next question which is this rather topical and interesting one about Cambridge. *There has been publicity in the Press recently about opposition to a smoke control area in Cambridge, where residents wish to burn logs and say that Cambridge has no smoke problem anyhow. Two questions arise from this: What does the Panel think about permitting log fires in smoke control areas? and secondly from the Warren Spring investigations reported at this Conference two years ago, is it not true that a town the size of Cambridge, population about* 95,000, *will suffer from domestic smoke as much as any part of one of the big cities?* The first part probably comes under the heading of solid fuel and I think perhaps I might ask our coal merchant what he thinks about log fires.

Mr. Robinson: I would agree that I love a good log fire, as long as it gives a really nice cosy atmosphere; I live right out in the country and I don't think there is any question of my causing a nuisance to anyone else. But nevertheless within a smoke control area a log fire would obviously not be permitted. Logs have a very high degree of volatiles; if you had a restricted chimney of any kind you would get a tremendous amount of tarry deposits, and would be polluting the atmosphere. This would be wrong according to the Act, but you could burn logs quite happily in your garden without the slightest legal effect unless a neighbour complained, but not in the house in a smoke control area. Before passing on to the second part of the question I would just like to make a comment about people who do burn logs. Often people have logs from their own gardens that they want to burn, when not in a smoke control area; would they please make certain that the logs are small, reasonably dried and carefully selected before being burnt, as in that way you get a much better fire and you do reduce the smoke pollution. But on the second part, whether Cambridge should be a smoke control area, and whether it will suffer from domestic smoke as much as any part of one of the big cities—I would say no, it will not. Cambridge is a place of about 95,000 population, it is surrounded by open country in the Fen area and there is quite a reasonable movement of the air. It will not suffer as badly as one of the black areas and I would say that this is a question of degree and of priority. If there is going to be any difficulty in the availability of the appropriate appliances or fuels, then I would like to see priority given to the black areas.

Chairman: I think it is the policy of the Ministry if possible to deal with the black areas first, but at the same time there has to be no damping down of the enthusiasm of other areas, who, although not black, would like to implement the Act. Would any other member of the Panel like to speak either on log fires or Cambridge? I think we must take it that Warren Spring's investigators are capable, knowledgeable people and have proved that this particular area will suffer from domestic smoke as much as any other part of a big city with a population of this size, but I think it is quite a controversial point about whether one should use logs in a fire, either in a smoke control area or not, and also I think we might link with that this question of burning rubbish in the garden, which was sent up by several people. *What is the position in a smoke control area of burning rubbish in your garden?* Mr. Robinson said of course you can burn rubbish in your garden provided you don't get an objection from a neighbour. I think probably that is the official view.

Would any member of the Panel, Mr. Draper perhaps, as an ordinary citizen, not connected with oil or any other fuel, like to have a word on this?

Mr. Draper: As a private citizen I would say that it would be very awkward for those people with sizeable gardens not to be able to burn their rubbish, because very often the local authorities will not take it away if it is put in the dustbin. Thus rubbish that cannot be usefully turned into compost, can easily pile up. There is no doubt that a bonfire pollutes the air, so it is an undesirable thing but on the other hand to most people it doesn't mean doing it day after day. It only means that on one afternoon an effort is made to burn up the rubbish and I hope people on the whole are mostly able to see where the wind is coming from and only do it on a day which doesn't blow the smoke straight into a neighbour's house.

Chairman: Dr. Miller, as a member of a local authority, would like to have a word on this question.

Dr. Miller: I would say that any town of about 95,000 population where all houses were using soft or bituminous coal, will have the same smoke problem as an equivalent size of any large city. I don't think there is any doubt on this at all and therefore if a town the size of Cambridge wishes to go ahead with a smoke control order then I think that they should be encouraged to do so. As far as permitting log fires is concerned, I don't think that in general log fires can be permitted in a smoke control area. If you have to heat your house by means of logs all the year round you are emitting pollutants into the atmosphere day in and day out, but if you only get rid of your garden rubbish, you are doing it once a month or so for a short time, and I think while this is not ideal, it is something that we have got to put up with until we have an effective medium or easy priced incinerator.

Chairman: Perhaps Mr. Saword as a local authority official would like to say something.

Mr. Saword: First, a brief comment on the logs part of the question, I think that is just a variation on the old theme that there is nothing so cosy as a nice coal fire; it's an appeal to sentiment, and although our ancestors of a few thousand years ago used to kipper themselves in their caves over log fires, in 1962 we have found more efficient methods of heating our houses. At any rate so far as smoke control areas are concerned, logs are out and I fully agree with that. Now the question of burning rubbish. This really is a problem in areas where there are substantial numbers of houses under smoke control. In some districts of course the houses have large gardens and there is a fair amount of garden refuse to be got rid of. It would be a rather heavy burden on the public cleansing services to take that away for disposal; some of it obviously has to be disposed of on the spot by composting or burning. The question of bonfires is entirely a matter of moderation and common sense. There is nothing in the Act which makes a bonfire an offence against a smoke control order. A bonfire may be dealt with under the section concerned with smoke nuisances and it has to be proved that a nuisance is caused to the neighbourhood. Now some easy-going gardeners can spend quite an enjoyable time, apparently, by poking about with a bonfire, raking up everything they can get in the garden such as lawn mowings, green leaves, wet stuff of all descriptions, producing enormous volumes of smoke. They thoroughly enjoy it, but the neighbours don't! If a gardener will make a compost heap of all the wet, green materials and use one of the accelerators obtainable from a horticultural store, he can produce an excellent fertilizer which would do a lot of good in his garden. And if he restricts his bonfires to things like dead raspberry canes, apple tree and rose prunings, and things of that nature; gets them dry first, waits for a dry day, and then feeds the bonfire gradually so as to keep it flaming and not smoking, then we could all get by without any nuisance to anybody and the most sensible application of the Act.

Chairman: Now we have a question from the floor from Councillor E. Mann of the Worsley Urban District Council, who would like Mr. McKinnell to indicate *what progress has been made to ensure that there is an adequate supply of solid smokeless fuel?*

Mr. McKinnell: First of all may I answer the question in relation to open fire fuel, because I do know that this matter is perhaps of greatest concern to the question. It's generally known that we at the National Coal Board have been doing a lot of work in developing new open fire smokeless fuel. We have had a pilot plant working in Warwickshire for the last 18 months, and as you know, a pilot plant is there really to see that a commercial plant works properly when we come to put it up and that we don't break down as soon as we start to make the fuel. This pilot plant is coming near a successful conclusion of its work and I hope that before the end of this winter we will have this fuel with the merchants to do commercial trials. I myself have used quite an amount on my fire for trials and I can tell you it is a good fuel. Well that is only the first step; by next winter I hope we will be able to have limited quantities, on the market, and we have always said we will be in production by 1965 and that promise still stands. That is for the open fire, but we have so much fuel for openable stoves and closed stoves that we just do not know what to do with it. We have nearly five million tons of coke lying on the ground around the heart of England, which would keep all the smokeless zones going for years if the appliances were in the people's houses to burn them. Let the householder have the appliance she wants, but we do hope that the use of the openable stove will develop so as to enable the Smoke Control Areas to be created with the use of all these millions of tons of hard coke, marketed as Sunbrite, which are available now.

Chairman: Here is a question from someone who belongs to the mining industry: *Why is the success of the Birch Coppice pilot plant in Warwickshire shrouded in so much mystery?*

Mr. McKinnell: When one has a pilot plant, one is expecting difficulties and that is why the pilot plant is erected and one doesn't make headlines with the technical difficulties one by one as they turn up. These difficulties arise to be solved and over the last eighteen months they have been solved. It's just as simple as that, and we are now just about ready to let the public see the answers.

Chairman: I think the public would probably like to know what Mr. McKinnell means by "just about ready" because it must be some five, six or seven years ago that this wonderful new fuel, Bronowski's bullets or nuggets, was promised to further the formation of smoke control areas and the public are still waiting.

Mr. McKinnell: We have not in the last few years promised production before 1965; we will be in commercial production in 1965. The trade, the members of the Domestic Consumer's Council and a number of other people will see this fuel and will be asked to test it in their own fires before the end of this winter.

Delegate from Atherstone: We in Warwickshire in the mining industry are very concerned and whatever steps are going to take place next may be too late; we don't want them in 1965 or 1966; we want them in six months' time.

Chairman: I agree with you there sir. Here is the next question: *The Gas industry seems to be moving towards new processes for completely gasifying coal, making gas from oil, and importing natural gas. All these will provide smokeless heating at possibly lower costs, but will they not lead to a diminishing production of coke, or Gloco, on which the smoke control area programme so much depends?*

Mr. Maddocks: I should like, in attempting to answer this question, to qualify my remarks. I come from the West Midlands Gas Board, and it's obvious in a question of this kind that I have to give an answer which applies to the national position and not to the West Midlands Gas Board. It is true to say that with the new processes of making gas, and as we have all read in the newspapers with gas likely to come into this country from other parts of the world, there will be in the gas industry a certain reduction in the availability of the solid smokeless fuels that they are producing at present. But in saying this nationally the impact on the availability will be more on the denser varieties of coke which are not so suitable for the domestic market than on the continuous vertical cokes which are marketed mainly for the open fires. In the gas industry at present we are producing in the region of just over eight million tons of coke for sale, and approximately two and a half million tons of that is at present going to the domestic market, which means that there is still a substantial amount of good domestic coke which could be diverted to the domestic markets.

Even the Beaver Committee Report, written some time ago, states, and it is true to this day, that there are considerable amounts of gas coke going to markets other than domestic. When smoke control does develop these switches can take place, and the good domestic cokes diverted from markets that can use other types of fuels, which our friend from the Coal Board has just told us, are available in large quantities. But we in the gas industry are obviously not going to give up our present markets until we are certain that we can get good dependable markets that will get rid of our fuel throughout the year.

Chairman: I have had a question from Dr. Perry, Medical Officer of Health for Basford Rural District Council, who says: *Now that the Gas Boards are making a profit, can we now expect a reduction in the price of coke?*

Mr. Maddocks: I only read in the paper the other day, the same as all of you, that the gas industry had made a profit this year and that the Government have instructed the gas industry to make a far bigger profit next.

Mr. Hudson: It was pleasing certainly for the gas industry to announce that overall it had made a profit, in fact every Area Board made one in the year ending March 31 last, and to me it sounds a lot of money; between three and four million pounds, but in an industry the size of the gas industry, it's something like one per cent on its turnover. In addition to that, the Government have, as those who read the papers will know, asked nearly all the nationalized bodies to find further monies for internal finance. This means that we have at least to maintain that profit in the future and make some more. I think the most pleasing news that I have heard from the gas industry in the past twelve months is that in spite of the increased costs of the last one to two years, the price of gas was not being materially increased anywhere. It is hoped that the present price of gas will be maintained, and I would assure you that that is no mean achievement in these days of rising costs.

Chairman: The following question has been asked in several different forms, and now comes from a Councillor Blackwell of Ellesmere Port. He says: *It has been known in isolated cases, for merchants to deliver coal into a smoke control area, under the pretext that there was not sufficient smokeless fuel available. As far as I am aware there is nothing in the Act to prevent this, although the unsuspecting customer could find himself in trouble. Can anything be done to prevent this? That is, should the onus of selling coal to a consumer in a smoke control area be on the coal merchant or not?*

Mr. Robinson: On the question of supplying bituminous coal into a smoke control area, please don't let's generalize. Bituminous coal can be delivered into a smoke control area quite legally, but is it morally wrong to do so? Let us clear first of all the legal position. If any householder has got a house big enough to have the type of appliance with an approved stoker, such as an underfeed stoker, then the appliance can be exempted under the Clean Air Act, and bituminous washed smalls or singles can be used in that appliance. Therefore bituminous coal can legally be delivered into that household with no trouble and no problems, and without smoke.

However, regarding the ordinary open fires or openable closed stove in a smoke control area, it is the householder's responsibility not to make smoke. Now what is to prevent, under the present conditions, a householder buying pre-packed bituminous coal from some shop outside the area and bringing it to his house and burning it illegally? Can the coal merchant be blamed for that? No reputable coal merchant, however, would deliver bituminous coal into a smoke control area unless to a house with an exemption. It may interest you to know that the Leeds and District Coal Merchants' Association have published booklets, listing every street and household within the smoke control areas, and these have been issued to every coal merchant asking them to ensure that they avoid delivering coal into any of those areas. Furthermore, the National Federation of Coal Merchants has issued a memorandum urging its members not to deliver coal into smoke control areas, and I hope that this will go a long way to solving the problem.

I would like to reassure you that the official associations of coal distributors fully support the Clean Air Act in its implementation and will go out of their way to help to make the solid smokeless fuels available wherever there is a smoke control area.

Chairman: I would think perhaps the answer to that is that if the solid fuel distributive trade was as efficient as it should be, this difficulty of not having the right kind of fuel at the right time in the right place, would not arise and therefore there would be no necessity for a consumer to burn, and I emphasize burn, bituminous coal in a smoke control area. Whether they are allowed to buy it or not I think it's quite a different question, after all the coal merchant isn't responsible for what happens to the fuel when he has delivered it and that particular householder might want to take it to her country cottage or might want to give some to any aged relative who lives in a non-smoke control area. Why should we make the coal merchant a policeman, he is often accused of not being able to do his own job properly so how could he be expected to be a policeman as well. I will give Mr. Saword his chance to say something now and then I will come back to Mr. Robinson.

Mr. Saword: We have heard of some of the difficulties of securing the kind of control that the questioner has in mind. It is a fact that there are mechanical stokers in some of the larger houses and it is a fact that some people can buy pre-bagged coal outside an area and take it in. I might also add that there are some exempted premises inside an area, but all these can be regarded as little fringe difficulties. They could all be taken into account if the law was simply amended to make it a legal offence for a coal merchant, *knowingly* to deliver coal to a house covered by a smoke control order. The onus would then be on the local authority to prove that he delivered it knowingly and there would be no difficulty about that because we can keep all our coal merchants aware of the boundaries of our areas. Before coming to this Conference I started preparing a list of every street in areas within my city to supply to the local fuel distributors, at their request. I know perfectly well that the vast majority of fuel distributors are playing the game and are not only avoiding delivering coal in such areas, but are giving truthful advice to householders about it. There are, however, one or two people who may be tempted at times, when possibly they haven't any of the premium fuels in stock and they want to retain their customers. I do know of instances where coal merchants have told householders, that it would be quite all right if they took, say, one bag of coal in five of coke for lighting up or for livening up the fire, and that kind of advice is quite wrong. After all, in many of our other laws, like the sale of intoxicating liquors for instance, it's an offence for a person to buy and it's an offence for the seller to sell, and I don't see why we shouldn't apply the same principle in this case.

Mr. Robinson: I should like to comment that (*a*) there are plenty of smokeless solid fuels available; (*b*) there are the coal merchants, fuel distributors, to deliver them to you; (*c*) would you please ensure that your own household stocking spaces are big enough to prevent you from running out of fuel every week, because solid smokeless fuels generally speaking take up more space.

Chairman: A question from Alderman Miss Redfearn from the Blackwell Rural District Council. *Should there be a national fuel policy and which type of heating should be encouraged in the national interest?*

Mr. Maddocks: I really don't know what national interest is but I should imagine national interest is economy of fuel and quite candidly as far as I'm concerned I should say that the most sensible appliance to use would be the closed stove which gives efficiency and utilizes almost any solid smokeless fuel.

Mr. Robinson: I agree that there should be a national fuel policy. I don't think it's possible to define one particular type of appliance as an answer to this question. I think the real answer is to have a balanced development of all the smokeless fuels, solid and piped, and use each as efficiently as possible.

Dr. Miller: I feel that the best form of appliance to be used in the national interest is some form of appliance which heats the whole household and doesn't just heat one room in the house. Whether this can be done by the use of solid fuels or any other fuels is something that must be left to the experts.

Mr. Partington: My colleagues have not left me very much to say, but in my opinion the national interest is a variable factor and for instance, at the time of Suez it would have not been in the national interest to have used oil-fired heating; equally in 1947, when we were desperately short of generating plant, it would not have been of interest to have used electric fires. At the present time there is no shortage of any fuel, but no one fuel could possibly carry the whole of the potential heating load in this country, therefore it is in the national interest to use those appliances which make the best use of each of those individual fuels. For instance solid fuel appliances burning smokeless fuel, high efficiency gas and oil appliances and off-peak electric heating.

Mr. Draper: All the different types of fuel, have to be integrated and used throughout the country, so if any one fuel, was suddenly cut off, then there would be in general no complete paralysis. The question of Suez has been raised, and I would like to point out that it was an extremely serious situation in which people thought that all the oil fuels would be cut right off, and that industry in this country would practically have to shut down. In the event my colleagues who are on the distributive side did a lot of organization so that in fact no household oil fuel was even rationed at all during the whole of that period. That was about as serious a stoppage as one could visualize, so I humbly suggest that oil will continue to take its place among the top grade, high ranking fuels.

Mr. Saword: It is not possible to talk about one particular fuel being in the national interest. The one thing about which we all agree is that the modern approved type of solid fuel burning appliance, such as we are putting in smoke control areas, is infinitely better than the old type of kitchen range or stool-bottomed grate which have no merits of their own, and certainly waste fuel.

Mr. McKinnell: I think this is really one of the key questions that we have had today. There are about one in ten of the people of this country dependent on coal and coal is the cheapest solid fuel for domestic heating. I have dealt with what should be burned in the appliance and the appliance should be an approved one of whatever kind a person likes, whether it be an open fire, an openable stove or what you will.

Chairman: To sum up I would like to add that my organization amongst many others have been trying for some time to bring pressure on the Ministry of Power to have a national policy and we are assured that there is no intention whatsoever of declaring any form of national fuel policy.

The next questioner asks: *If I install oil-fired central heating in my house, is there any objection to the boiler being fitted in the kitchen? Would there be any smell, noise or other trouble? Would such an installation be acceptable in a smoke control area?*

Mr. Draper: I must divide this subject into two parts; in the small two- to four-bedroomed house, one generally installs a type of oil heating plant different from that in the bigger house. The small house has a small vaporizing burner plant which operates absolutely silently because there are no moving parts and from the point of view of noise such a boiler can be installed in the kitchen with the added advantage that the heat radiated from its surface, is used in warming the kitchen. From the point of view of smell a light type of fuel is used and I can assure you from personal experience that there is no need to have any smell of raw oil whatever, unless a joint is leaking. So while in the small household the oil heating is better installed with the boiler in the kitchen, the slightly larger six- to eight-bedroomed house generally has an automatic pressure jet burner type of boiler which has an electric motor to drive the fuel pump and the air fan. These make whirring noises to a different degree of intensity, so I would recommend to this inquirer that this type of boiler be located in an out-house. To the question whether such installations are acceptable in a smoke control area, the answer is of course yes, because such types of burners make absolutely no smoke. If anyone is interested in the small amount of sulphur oxides that are emitted from domestic boilers, I can assure you that the type of oil used in the larger boiler, that is the slightly heavier of two domestic oils, would only let out one-fifth as much sulphur as would be emitted from the equivalent solid fuel boiler and in the case of the boiler in the small house it would be one-fiftieth. Oil heating is therefore eminently suitable for a smoke control area and although oil is not known as one of the authorized fuels for smoke control areas, it is allowed by a so-called Statutory Instrument that an oil-fired equipment, properly used and properly adjusted, is acceptable.

Chairman: The question has come from several people on moisture in coke. A Councillor from Bingley asks: *My solid fuel always seems to be delivered during wet weather, much of the fuel in merchants' yards appears to be kept not under cover but exposed to the elements and thus absorbs a substantial percentage of moisture. Should legislation be introduced to prevent this?* Another question which ties up with that: *Should we sell solid smokeless fuel by volume instead of weight?*

Mr. Maddocks: There have been a lot of controversies on moisture in coke, notably one recent publication of course that has put it in the limelight. I can only talk of the gas industry and coke covers a wide range, but we in the gas industry are doing an enormous amount of work to try and ensure that the coke that is delivered to the customer has a fair moisture content. Now let us face it; coke must have some moisture and it is generally accepted that an acceptable figure is in the region of nine per cent. We in the West Midland Gas Board over the last few weeks, where we've had a spell of exceptionally dry weather and have been picking up coke from our main stocks which has been running at a moisture content of round about three to four per cent, and our main complaints have come from the customer that the coke is too dusty. I think everyone will agree that the Gas Industry have gone a big step forward in marketing an open fire fuel under the name of "Gloco", which is produced to a specification. We are doing everything in our power to see that the moisture content is within the specification limits. Furthermore, we are prepared throughout the whole of the gas industry if a customer does receive coke which is unduly high in moisture and at certain times of the year this does happen when we are picking up from stock, to investigate these complaints and if necessary, to give compensation. As far as selling by volume is concerned, instead of by weight, this may well be more detrimental to the customer than selling by weight. The density of coke varies from about 75 cubic feet a ton to 120 cubic feet a ton and as you really want to buy fuel by the therm, you are buying heat by weight rather than by volume. I have seen this practice in Scandinavia where coke is sold by the hectolitre measurement and I hope we shall not have to sell the fuel by volume and get away from weight. In any case the expense of changing over from weight to volume would be excessive.

Mr. McKinnell: First of all, referring to the report that received a lot of publicity a few months ago, it wasn't a very well balanced inquiry that was carried out. When you carry out an inquiry covering only the four winter months of the year including a period with a lot of snow on the ground, you must have extreme examples of moisture. The Molony Committee said that trouble should be met by distributors in adapting storage and handling methods which would minimize complaints, and in dealing promptly with genuine complaints by making a cash allowance or free replacement. That is a really well balanced statement on the subject in my view and we at the Coal Board as well as our colleagues in the trade and in the Gas Board, do, I assure you, take this problem extremely seriously. We are considering what we really can do to ensure that either there is a guaranteed measure of heat content in the fuel that you buy, or that you do get proper recompense for any complaints that you have. I hope that before many months are over, we will be able to publish something to show what we have been able to do. As to the question of selling by volume, I think this is really the wrong way to tackle it, and it would be a confession of failure on the subject of moisture, because excess moisture is a bad thing in itself.

Mr. Draper: I only want to ask a very quick question. I don't use this sort of solid smokeless fuel myself, but if I did and being an efficiency engineer, I would like to ask Mr. Maddocks whether he would be prepared to provide me with a solid smokeless fuel with negligible water content because I should feel fairly capable of adding it myself. If I bought a ton of coke with say less than one per cent moisture, I could get back to his recommended figure of nine per cent by adding twenty gallons of water to this ton of coke and I could get that twenty gallons of water a good deal cheaper than if I paid for it at the price of coke then, of course if he provided this dry coke to me, in order to give me a ton, he would have to provide two extra bags free for the same price. So I suggest that we really ought to buy a dry fuel which doesn't contain a whole lot of something that not only is not a fuel in itself but does detract as the last speaker said from the heat imparted to the boiler or your two rooms as the case may be.

Dr. Miller: In connection, with the last question regarding the wetness of the fuel we do not have this problem in Scotland at all. Apparently our smokeless fuel or coke is delivered in sealed bags which are sealed by the Gas Board and there is no complaint whatsoever of excessive moisture, as no one can interfere with the bags. They don't lie out and they don't absorb any more moisture than is in them when the Gas Board manufactures the coke.

Mr. Robinson: This is of course a very important question. Coke at gas works is often quenched with water to cool it down and the coke absorbs a certain amount of moisture in so doing. Coke also collects additional moisture when it is sent in open railway wagons to merchants' depots and is at the mercy of any inclement weather. The bigger distributors have methods of assessing moisture content and if they were given guidance as to the standard of normal moisture content to be expected, they could do something about it, but at the moment there is no basis on which the standard of moisture in coke is assessed, as far as I know. I think the distributors would welcome a clear definition.

I would certainly confirm that the distributor who is worth his salt would be very glad to meet, by additional weight or allowance, any problem that arises out of excess moisture.

If you are going to put fuel into paper bags then up goes the cost, it's as simple as that. My own organization and other distributors are pre-packing not only gas cokes, but Coalite, Rexco, and other fuels too, but it is a costly process and if you want the coke in that type of condition, then I am very much afraid that you will have to be prepared to pay for it.

Chairman: I think I'm right in saying that the standard laid down by the British Standard Institute for coke does have a factor governing the amount of moisture in it, but this is unfortunately at the point of production and does not apply at the point of delivery.

Mr. Maddocks: In the Gas industry, we are, as I have said before, producing coke to a specification, the specification is within the British Standard 3142, which lays down a moisture content; it lays down a fire time and more important still of course it lays down sizing limits. This is for an open fire coke, which as I have said before, we are producing more-or-less throughout the whole of the British Isles now under the name of Gloco.

Chairman: *When is coke likely to be produced to British Standards even in Warwickshire?*

Mr. Maddocks: We are producing an open fire coke at Coventry and other places in the Warwickshire area to the British Standard.

Chairman: The difficulty here is that you are producing it, but is it delivered at the point of consumption to the same standard as when it leaves you?

Mr. McKinnell: I think the question really may be about closed appliance coke rather than open fire coke, and there isn't yet a standard for closed appliance coke, but as probably everybody in this room knows B.S.I. are working on that. There are technical difficulties and I am not going to say when a standard will be produced, but I do hope that with or without a standard the producers and the distributors will together be able to give a reasonable deal to the customer on this subject and the new fuel being developed in Warwickshire will have virtually no moisture.

Chairman: We come to rather a long query which covers the provision of means of ignition to fireplaces in houses built after the passing of the Clean Air Act, 1956, and in accordance with the Model Byelaw, Section IV Buildings, dealing with smoke prevention. In the case of such houses the Council have seen to it that the houses were provided with " . . . such appliances for heating and cooking as are suitably designed for burning any of the approved smokeless fuels," but have not required at the same time that means of igniting the solid smokeless fuels be provided. The question is: *Does the Model Byelaw quoted give a local authority power to have insisted on the provision of means of ignition, and if not, does the panel agree that there is a gap in the legislation regarding grant aid for adaptation to fireplaces and that the Model Byelaw should be amended to cover this point in houses built in future?*

Mr. Saword: It is rather a complicated question, and I think there is much to be said for clarification, by the Ministry, of the requirements of the Byelaws. But I doubt whether the Ministry would take a very firm line about ignition under the Byelaws, because they don't wish to tie anybody down to gas or electricity and they still suggest that local authorities should allow sticks and paper, as in their Model Exemption Clauses (see Circular 28/60) where gas is not available. I think the questioner is perhaps tying this question of ignition and grant aid too much to the date of the Byelaws rather than to the date of the passing of the Act. The D-day, as you might call it, for payment of grant is for houses built before the date of the passing of the Act, July 1956. Parliament had in the Act made provision for smoke control orders and anybody who built a house after July, 1956, would know (if he lived in a black area, at any rate) that a smoke control order was a possibility, or even a probability, and therefore if he neglected to put in an approved type of appliance with satisfactory means of ignition after that date he did so at his own risk and expense.

Chairman: Now we have a question from the Public Health Inspector of Kingswood Urban District Council which asks: *What experience have members of the panel had in seeing that compliance with smoke control orders is maintained? What remedies are available to local authorities other than prosecution? Have there been any prosecutions under Section* 12 *of the Clean Air Act?*

Mr. McKinnell: It is mainly an industrial problem that I am going to answer rather than a domestic one, but perhaps the questioner is thinking of industrial premises just as much as domestic. I do recognise the reluctance of local authorities to prosecute and we have in the National Coal Board a pretty extensive technical advisory service which is available to go out and help, in particular the small factory that is in trouble over smoke and grit. We have spent many, many hours on individual plants at the request of the local authorities and with the concurrence of the manufacturer or the owner of the plant or vice-versa trying hard to solve the problems of that plant and often with success.

Chairman: I should think the answer is the same on domestic lines. Helpful advice in the form of demonstration I think would be very much better for someone who is perhaps contravening the Act, than immediately coming down with the prosecution which is not really as Dr. Carter said this morning, our way of doing things. Now we come I think to the last question which is *the apparent unfairness of the forming of smoke control areas adjacent to a mining village or adjacent to people who have concessionary coal. What is to be done about it?* says the questioner.

Mr. McKinnell: A few months ago the National Coal Board completed an agreement with all the workers' unions by which they agreed to provide smokeless fuels to given value to anyone living in a smoke control area in lieu of the coal to which they were entitled. I think that is all I need to say.

Mr. Robinson: I don't really think this presents the problem that it did up to a few months ago. I think there is now nothing to stop the ordinary development of the Clean Air Act to take its place in the mining areas as well, in view of this new arrangement between the unions and the Coal Board. The problem of prejudice does still continue and it will have some effect for some time, but otherwise I don't think there is any other problem.

Mr. Draper: I would just like to suggest that the alternative fuel which the coal mines should supply to their employees, should be oil; there are several advantages there, in the first place the coal mines would have more coal to sell and they could increase export and in the second place, which of the coal miners wives wouldn't like to be a Mrs. 1970?

Chairman: I'm wondering if the difficulty here is, as it is very often in these agreements, that the trade union leaders agree, but do the members of the trade union agree and it would appear from reports from quite a number of areas adjacent to colliery villages that there is found to be real difficulties in these areas.

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The session ended with an expression of thanks to the members of the Panel, voiced by the Chairman and supported by the applause of the audience.

INCINERATION AND WASTE DISPOSAL

by

S. Cayton

*F.R.S.H., M.A.P.H.I., M.Inst.F. M.Inst.P.C.**

THE Clean Air Act, 1956 placed in the hands of local authorities in Great Britain the power to control almost all sources of smoke whether it be emitted from old or new buildings serving industry and commerce, or from dwellings built or to be built. It is true that the smoke must usually be emitted from a chimney or an opening of some kind, but exceptions were made in two seemingly insignificant cases—colliery spoilbanks (Section 18) and the burning of waste in the open air. (Section 16).

The purpose of this paper is to direct attention to the problems associated with waste disposal, with particular reference to the open burning of waste, and to the growing use of incinerators as an alternative thereto. The weaknesses of incinerators are discussed and local authorities are urged to provide alternative means of disposal wherever possible.

The Basis of the Problem

In less than twelve months the defences included in Section 1 of the Clean Air Act 1956 will no longer apply and from then onwards all stoking must be mechanical. In West Bromwich hand-firing has fallen to 2½ per cent. of the solid fuel boilers but oil is now used in 47 per cent. of all furnaces. This means that whereas up to 1957 it was possible to throw all kinds of factory waste into the fire tube of the boiler, this is now neither possible nor permissible.

In considering this problem we must also have regard to the changing nature of refuse. Not only has it increased in volume but also quite naturally, it includes the new materials now in general use, such as plastics in various forms, bituminized paper and hessian, all of which are notoriously difficult to burn without smoke. As members of a family or as workers in factories, shops or offices we all make our contribution to the total and we are vitally concerned both individually and as a nation, that the disposal of our discards should be hygienic, effective and economical. The choice must be, either incineration or some modern refinement of controlled tipping.

Small Incinerators

Under this heading it is proposed to deal with incinerators other than those operated by local authorities. Wide variations in the types of refuse to be dealt with necessitate that they should be broadly classified so that the extent of the problem is clarified.

(1) *Clean Wastes.* Office refuse, including carbon paper. Shop refuse, including paper, fibreboard boxes, wooden crates, baskets, straw and wood wool.

(2) *Dirty Waste.* Plastics, including offcuts from upholsterers and car trimming shops. Oily waste and sludge. Rubber and roofing felt. Bagging, carpets and other textiles.

(3) *Granular Wastes.* Wood (offcuts), sawdust and cotton waste.

(4) *Liquid Waste.* Spent oil and inflammable liquids, cellulose and paint shop waste.

(5) *Animal carcases.* Pet animals and diseased carcases.

The items in category (1) are easily

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* Chief Public Health Inspector and Cleansing Superintendent County Borough of West Bromwich.

reduced in bulk but are very liable to cause emissions of particulate matter, especially charred paper.

The materials mentioned in (2) are very liable to produce a thick black smoke and a strongly acid effluent gas whilst those in (3) involve the handling of enormous bulk (sawdust being an example) and in most cases they are highly volatile.

The liquids in category (4) have a higher calorific value than the other categories but they are likely to produce oily fumes, smuts and acid. Some large industries will regularly produce a refuse which will contain elements from all of the first four categories enumerated.

Category (5) is a special case and more likely to be dealt with by the local authorities.

Charging the Furnace

In the burning of any fuel experience has shown the need for a continuous charging of fuel and air in the right proportions in order to achieve satisfactory results. This same basic principle applies to the burning of waste materials. The charging of large batches of fuel into the furnace serves to quench the burning fuel bed upon which the charge is dropped, and excessive volatilization of gases from the new charge produces a back pressure in the furnace which restricts the flow of air.

An inadequate supply of air for combustion results in increased gaseous and solid pollutants being emitted from the chimney top due to incomplete combustion of carbon and hydrocarbons. In fact, burning can be said to progress in the following three stages:

(1) When the fuel is charged, a rapid release of volatiles temporarily overloads the furnace with combustible and non-combustible gases and tends to restrict the inflow of combustion air. Incomplete combustion results and smoke is emitted.

(2) As the volatile matter is burnt off, a period of intense burning takes place whilst the fuel/air ratio approaches optimum conditions. Relatively good combustion results.

(3) As burning intensity declines there is an increased air flow into the furnace, with a resultant cooling of the gas stream and a second period of incomplete combustion.

Large batches of refuse per charge generally produce heavier particulate emissions than the smaller charges. Consequently, small charges at frequent intervals are to be preferred and there is no doubt that continuous mechanical feeding would be the ideal procedure. As this is not possible a stoker must be sought who will "treat the plant not as a super dust bin but as a machine to be loved and cared for "[1]. Where can he be found?

Incineration has the advantage of greatly reducing the bulk of the refuse and it is agreed that it should be conducted under such conditions as will achieve:

(1) Maximum combustion efficiency so that the minimum quantities of the products of incomplete combustion, such as smoke, tars and malodorous compounds, are discharged into the atmosphere.

(2) Complete combustion of combustible solids, resulting in the maximum reduction of volume.

(3) Maximum retention of solids within the system, so that the least possible quantity of ash and and charred residue is discharged into the atmosphere.

Too often is " maximum reduction of volume " the sole criterion in the design of incinerators regardless of points (1) and (3).

Pollutants emitted by incinerators include smoke, dust and gases such as ammonia, organic acids, esters, phenols, aldehydes and benzene; under adverse conditions these gases may total 60 pounds per ton of refuse burned[2].

Incinerators under The Clean Air Act 1956

Incinerators are included in the

definition " Industrial Plant " (Clean Air Act, 1956, Section 34(1)) and local authorities must therefore be notified of new installations by " any person who installs," who may be the contractor who erects, the purchaser, the manufacturer or any other person concerned. They may also seek formal approval for the installation from the local authority. If the equipment is capable of burning one ton or more of solid waste per hour, it " shall be fitted with plant to arrest grit and dust." Some authorities suggest that pollution by grit and dust is more substantial in this case than pollution by smoke, and it is of interest, and not without significance, that the Minister has reserved the right in Section 3 (3) to deal himself, if he so decides, with any applications for approval under this section. Open incineration must comply with Section 16 that is not create a smoke nuisance, and new chimneys need approval for height under Section 10.

Municipal Incinerators

All the points made under the heading " Small Incinerators " apply equally to municipal incinerators, some of which are quite small. A few large municipalities, however, such as Birmingham and Glasgow, cannot avoid incineration and they should install electrostatic precipitators, since it is considered that no other method of grit arrestation can reduce the emission of grit and dust to the absolute minimum. It is further considered that unless this standard of equipment can be provided and maintained, incineration should be replaced by other methods of disposal.

This may be a hard doctrine and more difficult to accept in the case of existing small plants than of large new ones. It is not impractical, however, for all that is suggested is the discontinuance of the use of the incineration cells of the plant in favour of another method of disposing of the " tailings "—the residue after dust, cinders, metals, paper, textiles and other saleable items have been recovered. The insertion of a really effective form of grit arrester into the settlement chamber of any existing municipal type of incinerator, large or small, is likely to be difficult, costly and of doubtful value.

The Alternatives to Incineration

The disposal of refuse by " Controlled Tipping " or " the Bradford System " is almost traditional in Britain, being used by 400 of the 450 local authorities which make annual Costing Returns to the Ministry of Housing and Local Government. The high cost and difficulty of recruiting suitable labour has probably caused some lowering of standards compared with those of former years, particularly before 1939. This has resulted in some justifiable criticism, but the system is bacteriological and biologically sound, if properly operated. The growth of population and the development of extensive and densely populated conurbations has produced an acute shortage of land within easy reach of the collecting area which is suitable for reclamation by this system. Together with the growth of population has come the expansion of industry and commerce which is also seeking to dispose of refuse of increasing volume and complexity.

Since there are these two interests—municipal and commercial and industrial—competing for space in which to dispose of refuse which in both cases is equally necessary and unavoidable, it is considered that they should be united under municipal control. Private tips are almost invariably crude, and extremely crude where they are not overlooked by ratepayers who make their complaints heard. Therefore, in the interests of both hygiene and good rule and government, the case for municipal control seems unassailable and indeed it is likely to be welcomed by industry.

The primary objection, however, is lack of space. Here, a revision of generally accepted ideas of a reasonable haul to tipping ground may be needed, particularly in industrial areas, together with the acceptance and development of the practice of regional disposal of all refuse. Whether space for tipping is abundant or scarce, there are mechanical means at our disposal, which are as yet not widely utilized, to do the work to a higher hygienic standard, and conserve tipping space by better extraction and compaction, at the same time enabling the avoidance of atmospheric pollution from the many hand-fired incinerators which are replacing many hand-fired boilers.

Treatment of Refuse

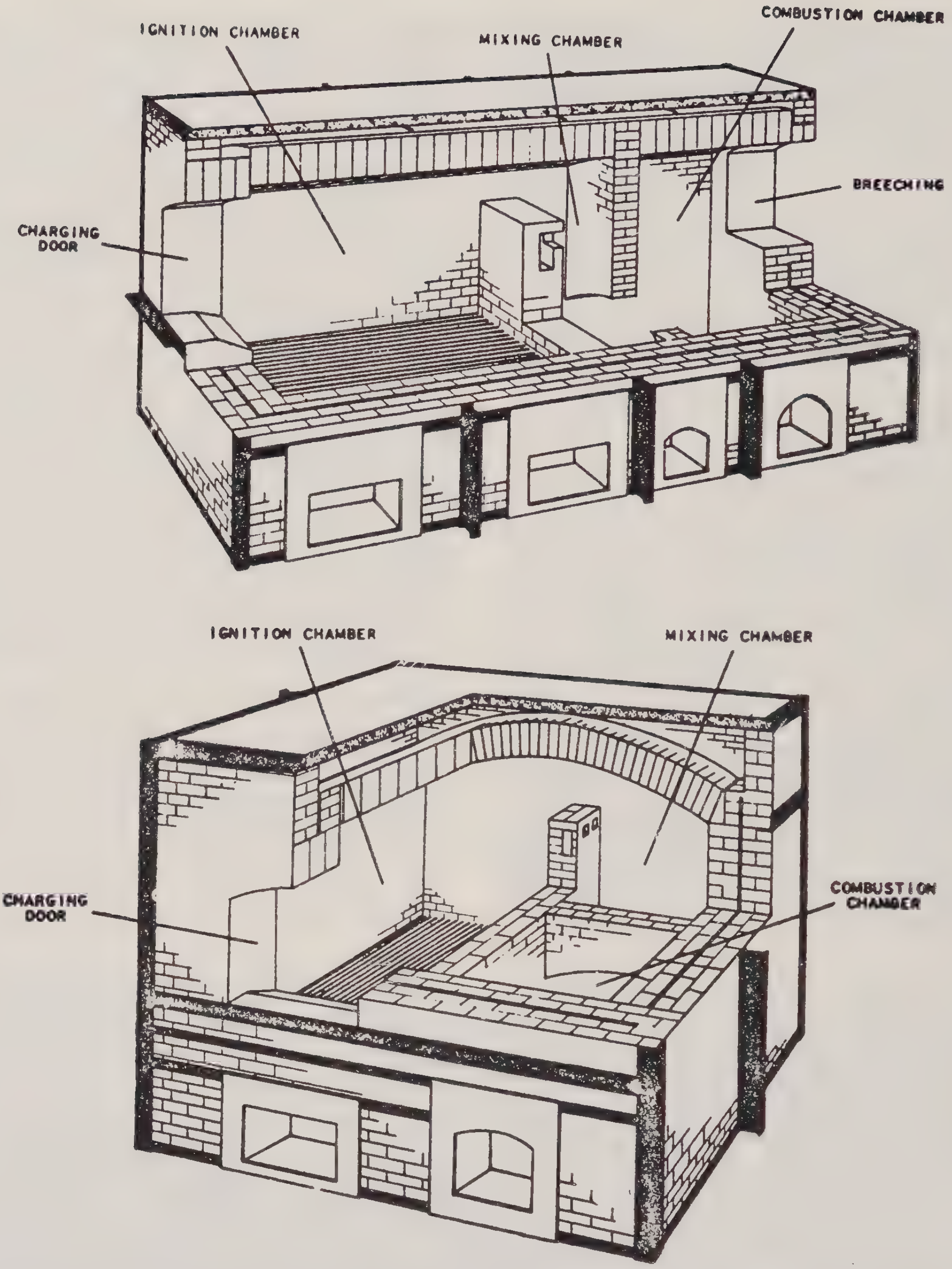
(*a*) *Composting*

An increasing number of local authorities in Great Britain are turning to improved types of composting plants which will produce an innocuous material which is bacteriologically satisfactory. All pathogens are destroyed by the natural heat generated in the decomposition processes and the resulting material may be saleable as a soil improver. Tipping space or other means of disposal will be needed to deal with the articles rejected from the refuse, such as bricks, pottery, glass and those materials which cannot be composted, (the volume and weight of these discards will vary according to the quality of compost desired) and an area of land for maturing the compost will also be required. If a sale of the compost cannot be made, the material can be tipped without covering material and also without any risk of nuisance from paper, dust or insects, the first two of which have been so macerated and intermingled that their nature has completely changed, and insects and their larvae are destroyed. The original bulk is considerably reduced in the process and if a market for the compost can be developed and maintained the discards represent only a small percentage of the original material.

(*b*) *Pulverizing*

An efficient unit to pulverize the " tailings " which remain when all saleable materials have been removed is a worthwhile alternative to the incineration cells. It is simple in operation, low in maintenance costs

A typical example of refuse incineration on a factory site



Cutaway views of U.S.A. incinerators. Above: an in-line multiple chamber type. Below: a retort type multiple chamber incinerator. From a Brochure by J. E. Williamson, R. J. MacKnight and R. L. Chass, Los Angeles County Air Pollution Control District (see References)

and quickly reduces the volume by at least a half. The resulting material can be tipped without any special precautions and settlement and decomposition within the tip is rapid and inoffensive.

(*c*) *Pressing*

Crude or pulverized refuse can be pressed into bales without the necessity for baling wires, to a density of about 38 lbs./cubic foot. This again halves the volume to be disposed of, a very important consideration if a long haul to the tipping site is necessary. A 100-ton press capable of doing this type of work was exhibited at the Conference of the Institute of Public Cleansing held at Hastings in June 1962.

Treatment of the Tipping Site

The crushing or filling of boxes, hollow drums and containers is one of the recommended steps in the formation of a well controlled refuse tip. This is probably often neglected as a result of the lack of labour for the purpose, but the deficiency is made good at least in part by the use of mechanical shovels, dosers and similar earthmoving equipment, which of themselves give compensatory compaction. Much improved compaction and final stability can be obtained by the use of grid rollers or tamping rollers, weighing from 12,400 lbs. to 34,350 lbs., which may be towed by a mechanical shovel of sufficient power. Such equipment is in regular use for roadmaking and could be applied with advantage to the consolidation of the refuse and the conservation of the tipping area. The best results are obtained when layers of refuse are about three feet in thickness.

Experience in America

The American continent has experienced a phenomenal growth in population during the past 50 years and although this development has been rewarding, it has not occurred without creating certain problems, one of which is atmospheric pollution from backyard incinerators. Some American cities, such as Pittsburg, have no system of refuse collection as we know it in the United Kingdom. Consequently, much research has been carried out into the problem and it has been shown conclusively that the single chamber incinerator is a major source of pollution.

For some years the city of Los Angeles has been in the forefront in this work and, indeed, in the suppression of all forms of atmospheric pollution. In 1950 it put an end to the open burning of refuse in dumps (by District Rule 50 which became fully effective in 1957). From 1950 onwards, engineering designs for industrial and commercial incinerator units have been critically reviewed and improved.

In 1953 the first approved modifications to flue-fed single chamber apartment house incinerators were installed which consisted of the addition of after-burners in order to further combust the effluent gases. Subsequently, multiple-chamber incinerators were peveloped and by 1957 all burning of combustible refuse was banned except when conducted in approved multiple-chamber incinerators or some equally effective equipment. The major result of these measures was to eliminate most burning of combustible refuse in Los Angeles in favour of disposal in sanitary land-fill sites—or, as we would say, of controlled tipping.

Those operations which require the burning of combustible waste products are only allowed to be conducted through the use of multiple-chamber incinerators, and the allowable concentration of combustion contaminants has been reduced from 0·4 to 0·3 grains per standard cubic foot of gas at 12 per cent. CO_2. The use of incinerators which can comply with this standard is said to have reduced pollution by 90 per cent. compared with the emission from single chamber incinerators.

Conclusion

The clean air programme aims to achieve maximum reduction in air pollution. This objective can be attained only if activity and effort are directed simultaneously against all forms of air pollution.

The burning of refuse in the open or in unsatisfactory incinerators is tending to increase as a result of the mechanical firing of boilers and furnaces required by the Clean Air Act, 1957.

The problems associated with incinerators are discussed and only those well designed and equipped to retain grit and dust with the incinerator system are permissible.

It is suggested that local authorities can best deal with the problem by collecting trade refuse and accepting responsibility for its disposal even though this may mean some form of mechanical separation and treatment before transport to a local or regional tipping site.

Mention is made of various methods of handling refuse and also of experience and progress in U.S.A.

The Los Angeles standard for grit emission from incinerators is quoted.

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Discussion

K. Higginson (National Industrial Fuel Efficiency Service), said that when one was approached to open a discussion on a technical paper presented by a knowledgeable person such as Mr. Cayton, to an audience such as the one before him, there was always the feeling that a double-edged sword was being applied. He was in the difficult position that whilst agreeing in part at any rate with the speaker, he must find something on which to disagree as violently as possible in order to provoke more thought and discussion. Although knowing only a very little about tipping of town's refuse, he was extremely interested, perhaps fanatically, on matters of heat and of combustion.

Mr. Higginson complimented Mr. Cayton on having selected a most interesting and serious subject, on presenting his subject so excellently, and also for having sufficient courage to state his own preferences so firmly before exercising his prerogative to criticise some of Mr. Cayton's points.

Mr. Cayton had referred to a practice, now neither possible nor permissible, with the exception of wood waste correctly handled and fired, of using the furnaces of a steaming boiler for disposal of factory waste. He thanked Heaven this was true as the boiler was never designed as an incinerator.

Given an incinerator designed correctly for the materials expected to be consumed, he could not agree that a smoke nuisance was likely, nor that smut or grit need occur. Much depended upon the operator and his selection of correct air ratios. He should be trained to handle the plant by various bodies, including ourselves, without nuisance, and to maintain it correctly. Plant design could be modified if necessary.

Mr. Cayton had chosen to favour controlled tipping, now in regular use and said to be as cheap if not a cheaper method of disposal than incineration. It probably was so in some localities such as Bradford, fortunate enough to have a legacy of disused quarries, and similar holes, close to the town and which when filled and consolidated became useful land. But some authorities were not so lucky, their transport charges were higher, and available holes had already been filled and levelled off. The residue after incineration was only about half the original bulk of material, perhaps even less if the metallic refuse was removed first. We should look toward the future and try to preserve our valleys and hollows for as long as possible.

Mr. Cayton, unfortunately, had not referred to the risk of spontaneous combustion of materials when using tips, yet when the refuse was of very mixed quality and type that must be a danger. There had been examples of its occurrence which he might comment on.

Mr. Cayton might also consider the heat value of present day refuse correctly incinerated. He would find that the daily quantity for a town of 100,000 persons could produce some 900,000 lb. of steam, enough to generate sufficient electric power to run the incinerator, or provide district heating or centralized hot water supplies.

He thought that our present day incinerators might not be good enough, or not correctly run. Refuse might need special treatment, particularly drying, since the cinder content was now much lower. In either case the problem was now brought forward for consideration to a body which had some power to request more research and better design. He congratulated Mr. Cayton for his efforts to focus attention on the disposal of waste materials.

Dr. J. S. Carter (Alkali Inspectorate) drew attention to the hazard of emission of toxic gases. The Minister of Housing and Local Government was considering extension of the Alkali Act to cover incineration of chemical wastes containing combined chlorine, fluorine, nitrogen, phosphorus or sulphur and the incineration of scrap cable for metal recovery. Increasing amounts of scrap cable coated with polyvinylchloride, etc., were being burned with emission to air of phosgene and hydrogen chloride. There was here both a toxic gas and a smoke emission problem. He believed the Minister would, if the proposals became law, consider applications for an order under Section 17(2) of the Clean Air Act, 1956, from local authorities employing suitably qualified smoke inspectors for control of the smoke emissions.

E. M. Birtwisle (Horsforth), drew attention to the similarity between refuse accepted as house refuse, and much of the material burnt in industrial incinerators. Burning in the past had been an easy method of disposal but in the interests of clean air it should now only be resorted to when other methods were not available.

Local authorities' schemes for refuse collection might need to be extended to the collection of industrial waste and the Society should consider submitting a memorandum to the Working Party on Refuse Collection proposed by the Ministry of Housing and Local Government.

G. A. Hiller (Leicester), said that very much more attention would have to be paid to the problem of waste disposal than had been the case in the past. Not only were the public becoming more sensitive to nuisances but much higher standards of boiler firing were being demanded of industry and business and it was essential that incinerators should come under the same strict control. In fact the feeding of an incinerator was much more important than the firing of a boiler.

Mr. Hiller did not agree with the suggestion by one speaker that in the cause of clean air all trade wastes should be disposed of by tipping and emphasized the very considerable heat value contained in many of these wastes which industry could not and should not be expected to disregard. Furthermore, the high costs of cartage would make even tipping much more costly in the future and it was quite impossible to come down positively on one side or the other as between incineration and tipping. He felt that incineration had got to be accepted provided the appliances measured up to modern requirements but, in this respect, found that in many cases manufacturers and users tended to be bound by tradition and were reluctant to make changes.

In the incineration of trade wastes it was necessary to go beyond the usual accepted meaning of best practicable means for dust prevention and any practicable means for minimizing emissions must be employed.

B. D. Allen (Coventry), said that all burning of waste and all incineration should be strictly controlled. All uncontrolled burning of wastes should be severely discouraged and wherever possible, prohibited by law. The National Society for Clean Air should strongly oppose the burning of wastes in the open air. He referred to the pathetic waffling from the platform on Thursday afternoon in relation to the burning of garden refuse and deplored it. This Society should strongly oppose any form of uncontrolled burning of waste, including garden waste, in the open air. He said that whilst controlled tipping offered a solution, some incineration would be necessary. There was a need for research on incineration and a great need to train personnel. In regard to the disposal of wastes from small factories be suggested that local authorities should assist in offering collection of trade wastes, possibly at cost, in order to make incineration unnecessary. He called the attention of delegates to the fact that in smoke control areas more and more factories were being incorporated and where incinerators were provided exemptions would have to be given and that brought other problems in its train. He felt that both tipping and incineration had some part to play but a great deal of further thought was necessary.

P. H. G. Grimmett (Wednesfield), said that Mr. Cayton indicated that the burning of waste in the open air was permissible under the Clean Air Act and concurred with the observations of Mr. Allen in that comments from the platform on the previous afternoon were rather woolly. He indicated that a good gardener does not have a fire with excessive smoke in his garden as he wished to retain the nitrogenous content for the benefit of fertilization and suggested that smoky bonfires might be a screen for other activities, *i.e.* talking to the blonde over the garden fence or alternatively slipping down the road for a "quick one". Mr. Grimmett intimated that a smoky bonfire was also a contravention against the Road Traffic Act if refuse was burnt and smoke created in such a manner as to produce a road hazard.

Mr. Grimmett intimated that he had received approaches for the disposal of confinement debris after the "happy event", concurred with the plea of Dr. Burn and also stressed the need for an extention of the municipal refuse collection service to overcome the activity of many members of the public who were exporting their rubbish all over England from the New Forest to the Yorkshire Wolds dumping their refuse on any corner in any place to disfigure the countryside, often at night from the boot of a fairly good quality car.

Mr. Grimmett suggested that people must not only keep their home clean, their garden clean, the air clean but must be educated to keep the countryside clean too.

Mr. Grimmett made mention of the difficulties of P.V.C. coated wire burning and the liberation of dangerous gases but in view of the contribution of Dr. Carter, Chief Alkali Inspector, he did not press the point.

Finally he asked Mr. Cayton if he felt that the disposal of spent engine oil by burning with the use of the special types of burner now on the market for this purpose was in his opinion the best means of disposal having regard to the release of metallurgic fume therefrom and understanding that vanadium, cadmium and beryllium is released in such process.

Councillor W. A. N. Jones (Birmingham), expressed his gratitude to the Society and the author of the paper. He was particularly interested when Mr. Cayton argued that in certain circumstances controlled tipping of refuse as against incineration could be the answer to the problem of waste disposal.

He drew the author's attention to the very grave shortage of tipping sites and the nuisances which arise at uncontrolled sites. In coming down on the side of disposal by efficient incineration methods he stressed the great responsibility of local authorities who must set their own houses in order first.

F. M. Shaw (The British Cast Iron Research Association) said that while he was not very knowledgeable in Mr. Cayton's field, he was at least familiar with one result of his activities, namely the recovery of ferrous scrap from household rubbish. This potentially valuable material contained such things as meat and paint tins still with some of their original contents, galvanized scrap, etc. Sometimes this was incinerated and normally it was baled. The result was scrap often containing combustible volatile matter (food remains, paint, etc.) and always containing incombustible volatiles (zinc and tin).

When melted down in cupolas making refined iron, this volatile matter could produce a fairly dense stack effluent. It was possible, in some cases, to burn the combustible smoke particles in the cupola itself, but the zinc and tin fume could not be got rid of in this way. Collection of the fume was technically possible but, at present, uneconomic. The refined iron producers could not be blamed for using such scrap (known as No. 5 Destructor Scrap) because they were performing a public service by paying the local authorities for it and reducing the amount of material to be tipped. In addition, they were doing a national service in recovering scrap. This point was only mentioned to show that in solving one problem (disposal of ferrous scrap) it was possible to cause another (air pollution).

W. H. Wattleworth (Royal Society of Health) stated that incineration must now be regarded as inevitable in smoke control areas. The demand for land for housing had made it impossible for local authorities to find suitable tipping space within their areas.

The problem of incineration was not new and already considerable experience had been gained in the large industrial areas. The old stepped grate incinerator, which was one of the earlier forms, had now been improved and in many cases did a good job of work.

Nevertheless, Mr. Wattleworth thought that modern incinerators, with secondary combustion chambers, properly controlled and guaranteed by the makers, could perhaps solve the problem. In some domestic areas smaller gas incinerators were in use. These were serving a very useful purpose.

J. Pickard (Blackpool), said although many manufacturers of trade-waste incinerators could be complimented on their efforts to produce appliances designed to eliminate the emission of smoke when turning trade waste this was not always the case. Appliances were causing concern to local authority officers in respect of nuisance caused by the emission of fly ash, grit, burnt paper, etc.

There was no doubt that more research was required in that field before local authorities were asked to give prior approval under Section 3(2) of the Clean Air Act, 1956. In the meantime, however, anyone desiring to install those incinerators should notify the local authority of the installation under Section 3(3) of the Act, and rely upon a guarantee of efficiency from the manufacturers.

Councillor W. A. Newman (Ipswich), said he had listened to all the experts and noticed how they differed. This made the task of the public representative difficult when he had to report back to the appropriate committee. Regarding bonfires he had a confession to make; every six months he had a roaring bonfire in his garden to burn up old agendas and those silly Government documents which came from the various ministries.

Mr. Cayton, replying to the discussion, thanked Mr. Higginson for his introductory remarks and for his acceptance of the duty of opening the discussion.

Incinerator makers, he said, usually produced one or two standard models which were of various sizes to deal with every variety of refuse. They might be successful some of the time but they frequently failed because the designer could not anticipate every eventuality and still produce an incinerator at an economical price. Large plants for local authorities only varied in detail. Where a plant was designed specifically for the waste to be handled, then the material was usually uniform in character and of sufficient quantity to justify mechanical handling for at least some part of the process. But, they all depended, ultimately, on manual stokers. Mr. Higginson had said they should be trained, but this was something they had been trying to do with boiler plant operators for years without success; hence the pressure for mechanical stoking. If they could not train a sufficiency of reliable men for the boiler house what hope was there of training yardmen working in wind, rain, hail or snow to "treat the plant, not as a super dustbin, but as a machine to be loved and cared for". (Ref. 1).

Mr. Cayton said he appreciated the fact that to practise controlled tipping a suitable site was necessary. Sites for tipping, conveniently situated in or near large towns, were becoming more difficult to find but at the same time the technical difficulty of transporting maximum pay loads of refuse was being overcome by pressing refuse into a transporting vehicle in the form of a high density bale. This system opened up the prospect of distant haulage of refuse to reclaim land at reasonable cost in preference to elaborate refuse handling incineration plants which still had to dispose of considerable residues in the form of dust and ash after sorting and incineration.

Spontaneous combustion and malicious tip fires were an ever-present problem but the admixture of one waste with another and a generous covering of "spoil" arising from building activities was usually sufficient to keep fires to a minimum.

Regarding the heating value of town's refuse Mr. Cayton pointed out that the cinder content was declining, as Mr. Higginson said, and indeed as a result of smoke control, was likely to be progressively reduced. Electric heat and power could be obtained much more efficiently from power stations. Consequently, he thought the day of steam generation from refuse to produce electric power was over.

Mr. Cayton particularly welcomed Dr. Carter's contribution to the discussion especially as he had already played a prominent part in the proceedings of the Conference. He was pleased to note that the Minister of Housing had recognised the significant contribution made to the total amount of pollution by the open burning of waste for the recovery of metal and he had no doubt that authorities with qualified inspectors would seek delegation of powers to enable them to deal with contraventions of any Alkali, etc., Works Orders which may be made to control cable burning in particular.

Replying to Mr. Birtwisle, Mr. Cayton agreed that there was a similarity between refuse collected from houses and that from industry. Indeed the main difference was in the weight and volume. He further agreed that it would well be desirable for the Society to submit their views to the proposed Working Party on refuse collection and disposal.

In reply to Mr. Hiller the author said he was pleased to have support for the view that the disposal of waste by incineration must be under the same control as boiler firing, though he was unable to agree that "the feeding of an incinerator was much more important" but it was certainly more difficult to accomplish with the same efficiency as was now demanded in boilerhouse practice. Until this standard could be achieved it did seem that disposal by tipping was the only alternative. Though some industrial waste had a significant heating value, the majority was so variable in quality and laborious and difficult to handle that it's extraction and use was not economical. Wood waste was a possible exception and furnaces with mechanical firing had been designed specially for the purpose and were said to be giving satisfaction.

On the question of the cost of cartage, developments were taking place which, by pressing bulky refuse into purpose-made vehicles it would be possible to obtain economical payloads. Mr. Cayton agreed with Mr. Hiller that incineration could be accepted provided the appliances do measure up to modern requirements but this was not yet the case. He added that however successful incineration might be there was always some residue to be disposed of by tipping.

In answer to Mr. Allen, Mr. Cayton said he agreed that the extension of smoke control areas must inevitably include factories of all sizes, though he could not agree that incinerators should automatically be granted exemption. He said he would prefer to place the onus on the operator to show that he was in fact using the "best practicable means" to prevent atmospheric pollution rather than "any practicable means". Further, Mr. Cayton said, there was much more tipping space available than perhaps many of us realized and it was virtually certain that we were not yet making the best use of it.

The fact that there was a shortage in and around large towns and cities was creating a demand for better equipment, such as pulverizing plants, to conserve tipping space or to transport refuse greater distances, economically.

Mr. Cayton agreed that there was a lack of trained personnel not only for incineration plants but for boiler plants also, and in the case of the former he thought it was likely to continue.

Replying to Mr. Grimmett, Mr. Cayton said that the burning of waste in the open air was only permissible if it was done in such a way as not to cause a "nuisance to the inhabitants of the neighbourhood". If the public health inspector considered that he could advise his council that any particular open incineration was a nuisance, then action for an abatement order should be taken under the Public Health Act 1936. Mr. Cayton agreed that our standards of living and our way of life was producing more frequent renewals of items of domestic equipment such as washing machines, radios, television sets, furniture and other bulky articles, all of which were in his opinion house refuse, and consequently local authorities should collect it and let it be known that they will collect it either in their normal house-to-house refuse collection service, or by special arrangement. Discarded motor cars or at least the more bulky parts of them might also be in this category.

On the disposal of spent engine oil, Mr. Cayton considered that if there was sufficient to warrant re-use in a burner it should first be properly cleaned for the purpose.

Welcoming the contribution from Councillor Jones, who represented a progressive city which relied on incineration for the disposal of its refuse, Mr. Cayton said he was particularly gratified to hear him say that local authorities should first "set in order their own house" and he felt sure that the representative from Birmingham would endeavour to see that it was done.

Replying to Mr. Shaw, Mr. Cayton said that in mentioning one of the consequences of the recovery of ferrous scrap from household refuse he was raising a very pertinent point. Mr. Cayton said his own authority derived considerable revenue from the recovery of metal containers but they did endeavour to keep their bales free from paint and other objectionable constituents though he did not think the amount of food remaining in such containers was significant, but the presence of zinc and tin was inescapable. One alternative would be electrolytic de-tinning but this was only practised on a relatively small scale because of the cost of carrying empty and unbaled containers.

The whole purpose of the paper was epitomized in Mr. Shaw's final remark, namely that in solving one problem we were in danger of creating another.

In answer to Mr. Wattleworth, whose experience in a large city must be respected, Mr. Cayton said he did not consider that incinerators were inevitable and certainly not in their present form. He reminded his audience that the municipal incinerator had not materially changed in its design for many years and large local authority incinerators would not be satisfactory until they embodied a system of flue gas cleaning approximating to the standards being set for industry. In support of his view, Mr. Cayton said that one local authority was proposing to install electro-static precipitation in a plant now being designed. He said he considered this was the sort of standard to which we should aspire. Makers' guarantees were useless unless they could also guarantee the work of the operator. This was obviously impossible.

So far as domestic incinerators were concerned he said that we should not depreciate the results to be obtained by smoke control through the acceptance of a multitude of backyard incinerators, which had so ham-strung American efforts to achieve clean air.

Mr. Cayton agreed with Mr. Pickard that more research was needed in order to produce an incinerator which could be accepted under Section 3, but at present he would hesitate to recommend approval under Section 3(2), though of course a local authority would be entitled to "notice of installation" under Section 3(3). Mr. Cayton believed that Cleansing Officers who were not also Public Health Inspectors would appreciate the new problem which was created for them by the implementation of the Clean Air Act and enlarge their organization as might be necessary.

Mr. Cayton said contributions from elected representatives were always especially welcome and Councillor Newman's confusion was understandable. Circumstances differed very widely, even between himself and his neighbour, Birmingham. What was right for one district might be wrong or physically impossible in another. Mr. Cayton said he was sorry to hear that Councillor Newman burnt all his committee agendas and reports, for the paper on which they were written was valuable salvage even if the written words were not worth keeping!

In conclusion, Mr. Cayton thanked those who had contributed to what he felt had been a rewarding and for him, a stimulating discussion. He regretted that time did not allow more complete answers to all the points raised. He also expressed his appreciation of the attendance of so large an audience who had listened patiently throughout the final session of the conference.

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HARROGATE CONFERENCE

9th–12th October, 1962

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National Society for Clean Air

Harrogate Conference, 1962

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Association of Public Health Inspectors
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A. Gilpin
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W. A. Clement (Midlands Region)
R. Wolforth (Yorkshire Division)
G. B. Jackson (Yorkshire Division)
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Coal Merchants Federation of Wales
K. T. Diamond (Eastern Area)
Coal Utilisation Council
H. S. Maddocks
A. Robertson
College of Fuel Technology
Arthur Coe
Ian M. Coe

Davy & United Engineering Co. Ltd. (Steel Processes Division)
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P. B. Peart
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Dr. S. R. Craxford
Dr. Marjorie Clifton
Dr. L. E. Reed
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C. A. Deas
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R. D. Hammond

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Samuel Fox & Company Ltd.
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S. F. Moppett (Coke Dept.)
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Ministry of Health
Dr. A. E. Martin
Ministry of Health & Local Government for Northern Ireland
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K. H. Lynas
Ministry of Housing and Local Government
P. D. Coates
Ministry of Housing and Local Government, Alkali Inspectorate
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National Industrial Fuel Efficiency Service
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North Eastern Gas Board
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K. E. Laycock
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North Western Electricity Board
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North Western Gas Board
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Jean-Paul Detrie

Comité d'Action Technique contre la Pollution Atmosphérique (France)
Henri Perdon

Department of Health (Republic of Ireland)
F. E. Dawson

Municipality of Geleen (Netherlands)
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F. Emerson Ivey, Jnr.

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Dott. Vittoria Turolla

Organization for Health Research T.N.O. (Netherlands)
Dr. P. E. Joosting
L. J. Brasser

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Dr.-Ing Kurt Guthmann

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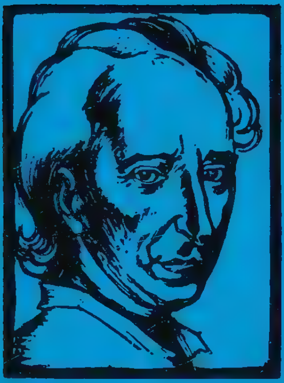
Clean Air Conference

Harrogate — 9th — 12th October, 1962



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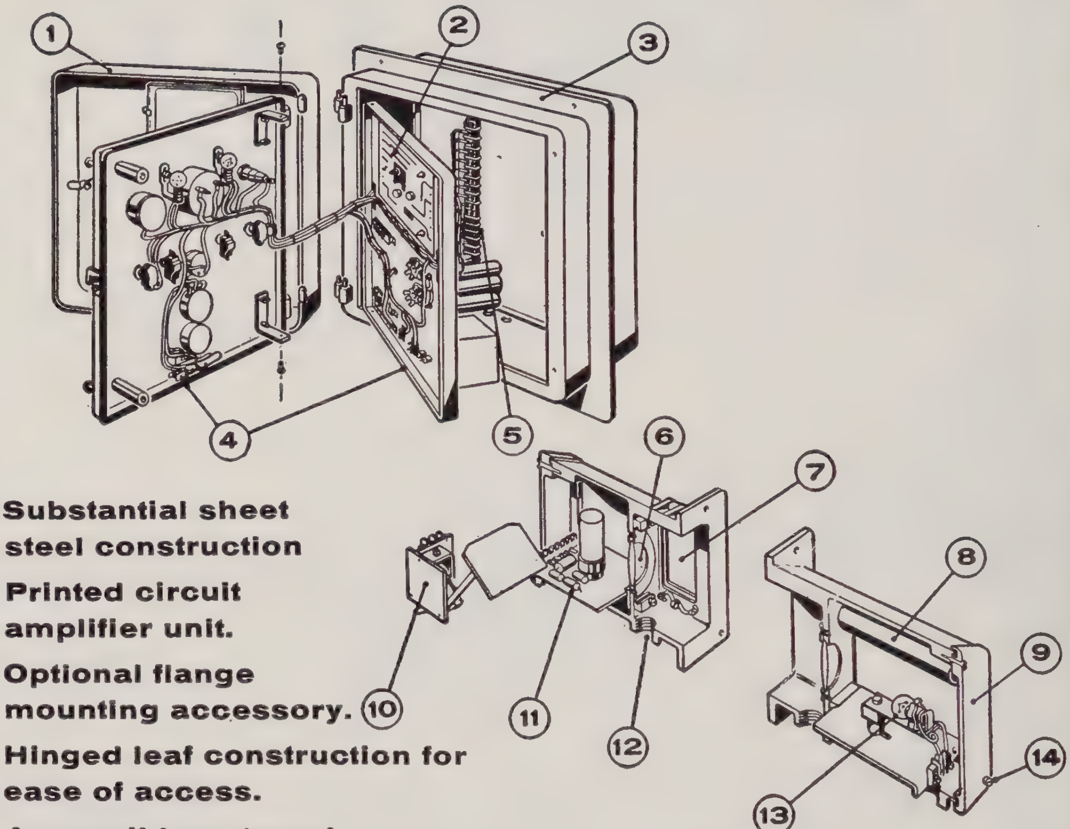

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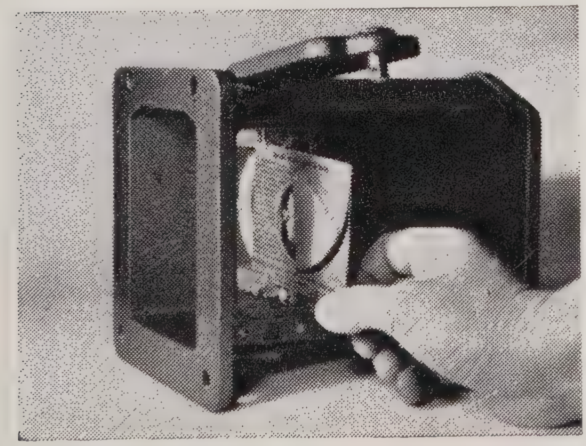

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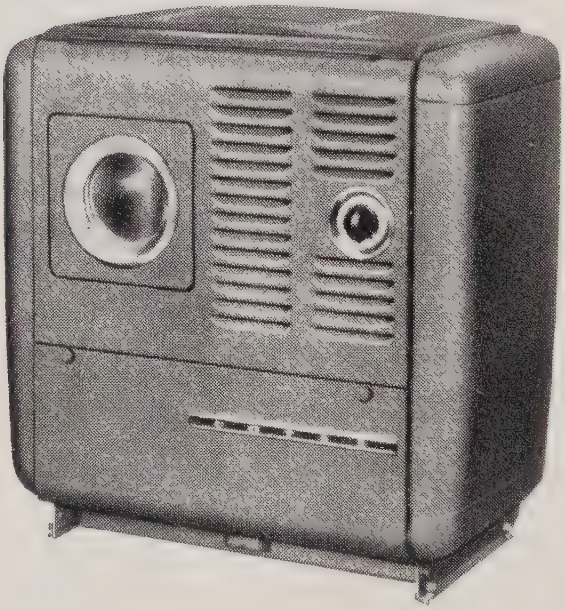

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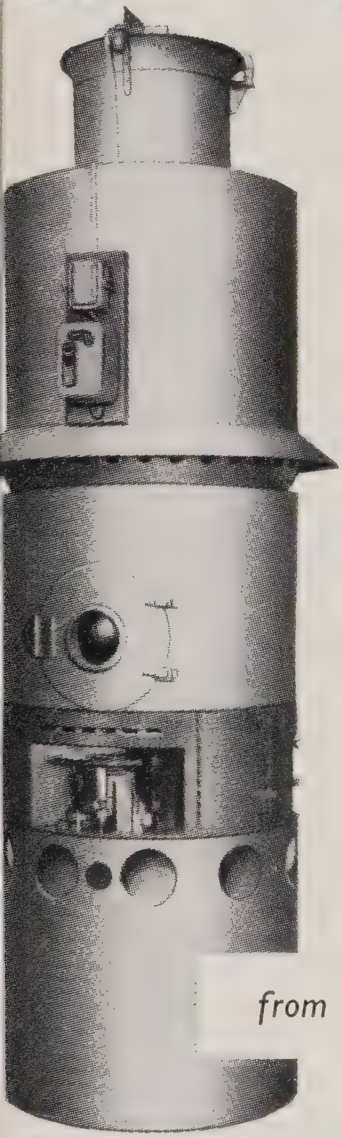

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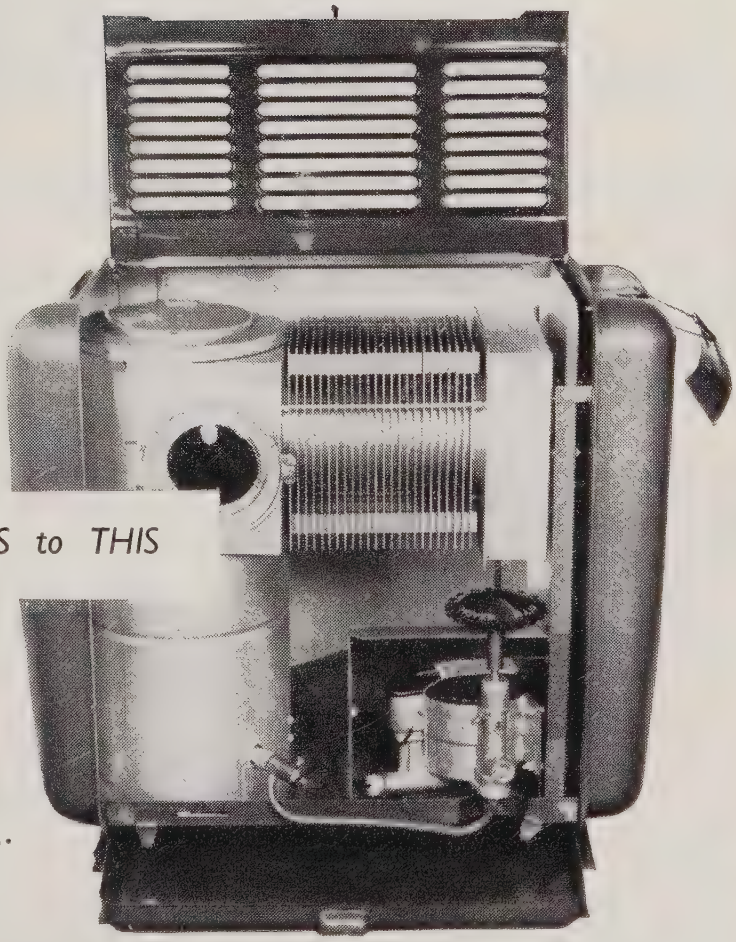

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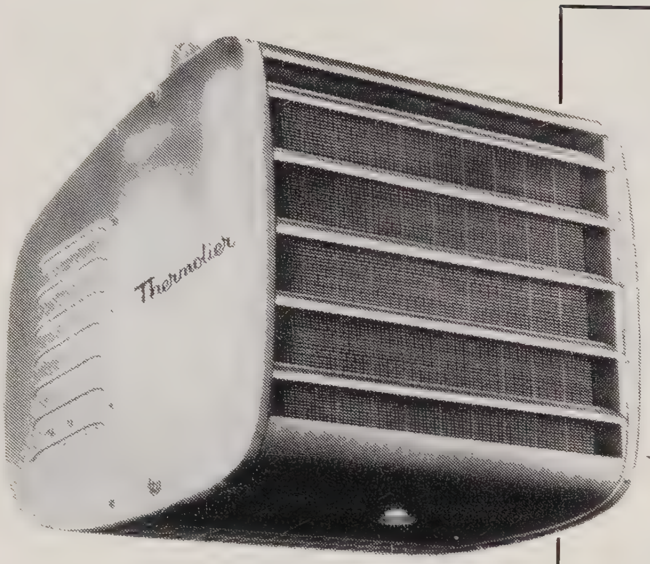

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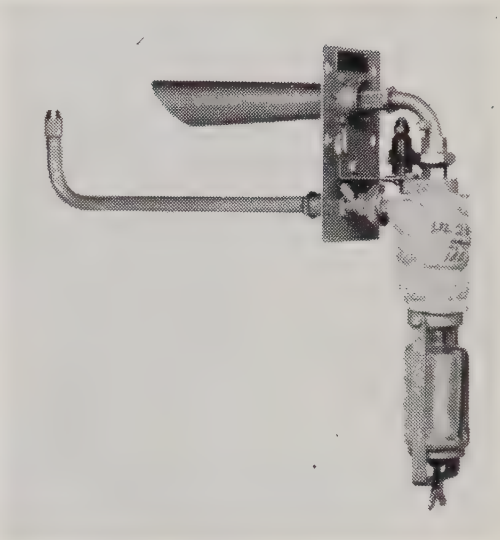

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NOTE THESE FEATURES

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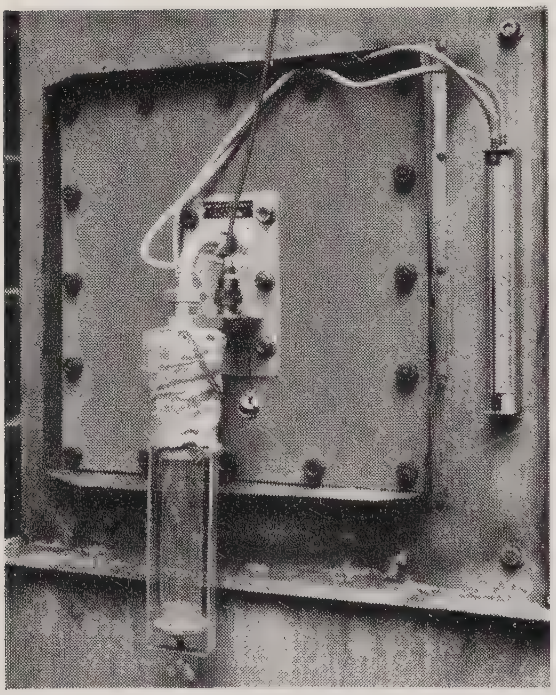

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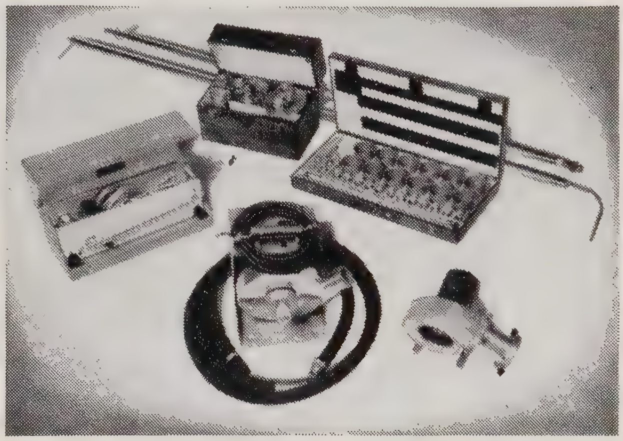

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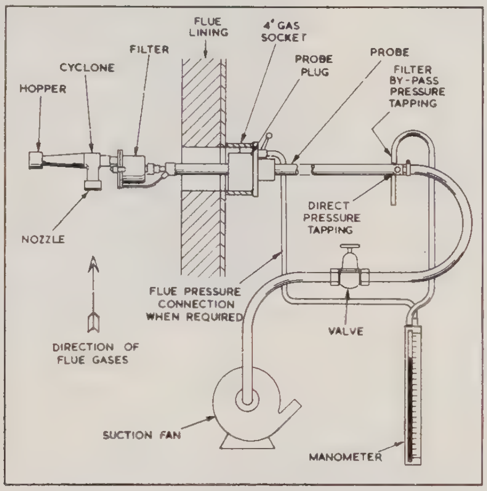

LAYOUT OF APPARATUS

PRINCIPLES OF OPERATION

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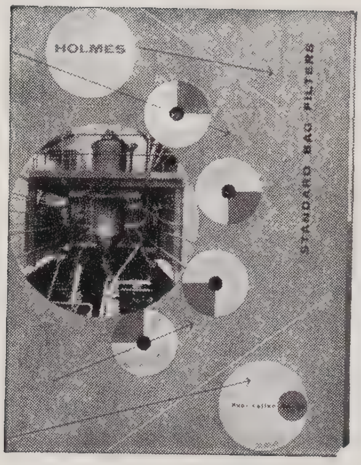

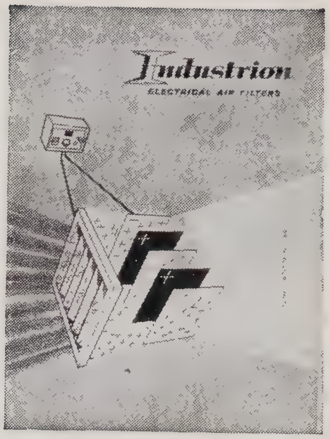

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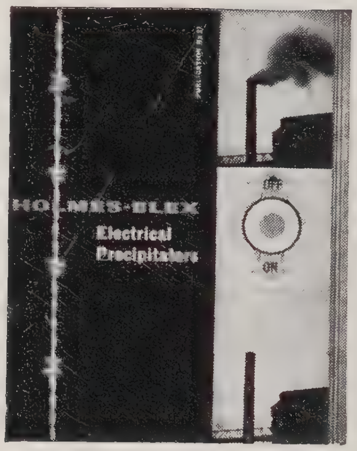

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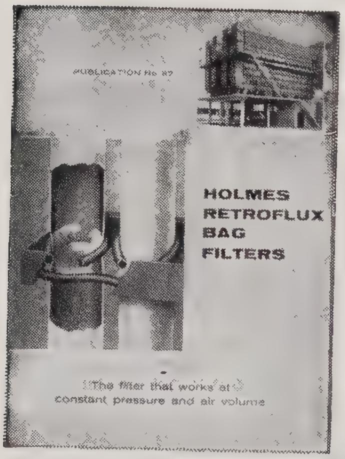

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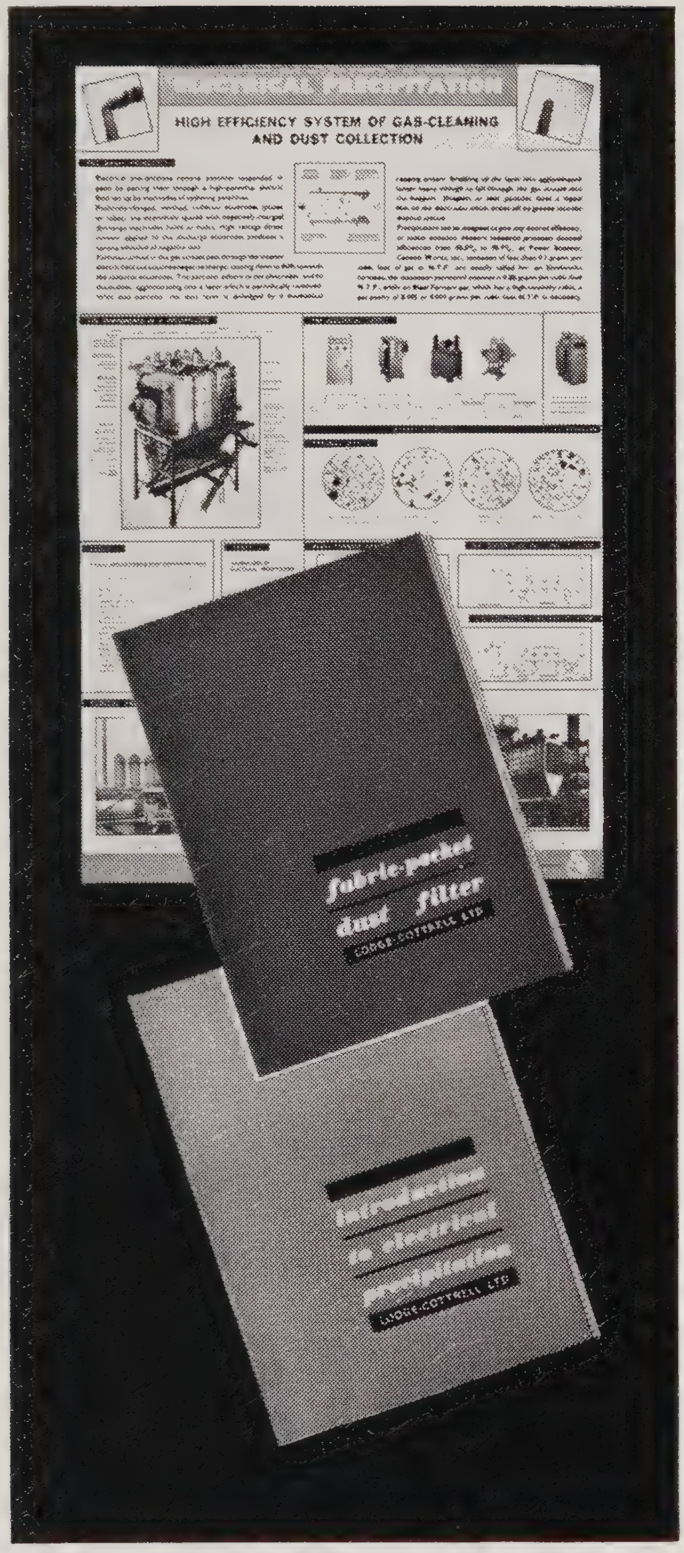
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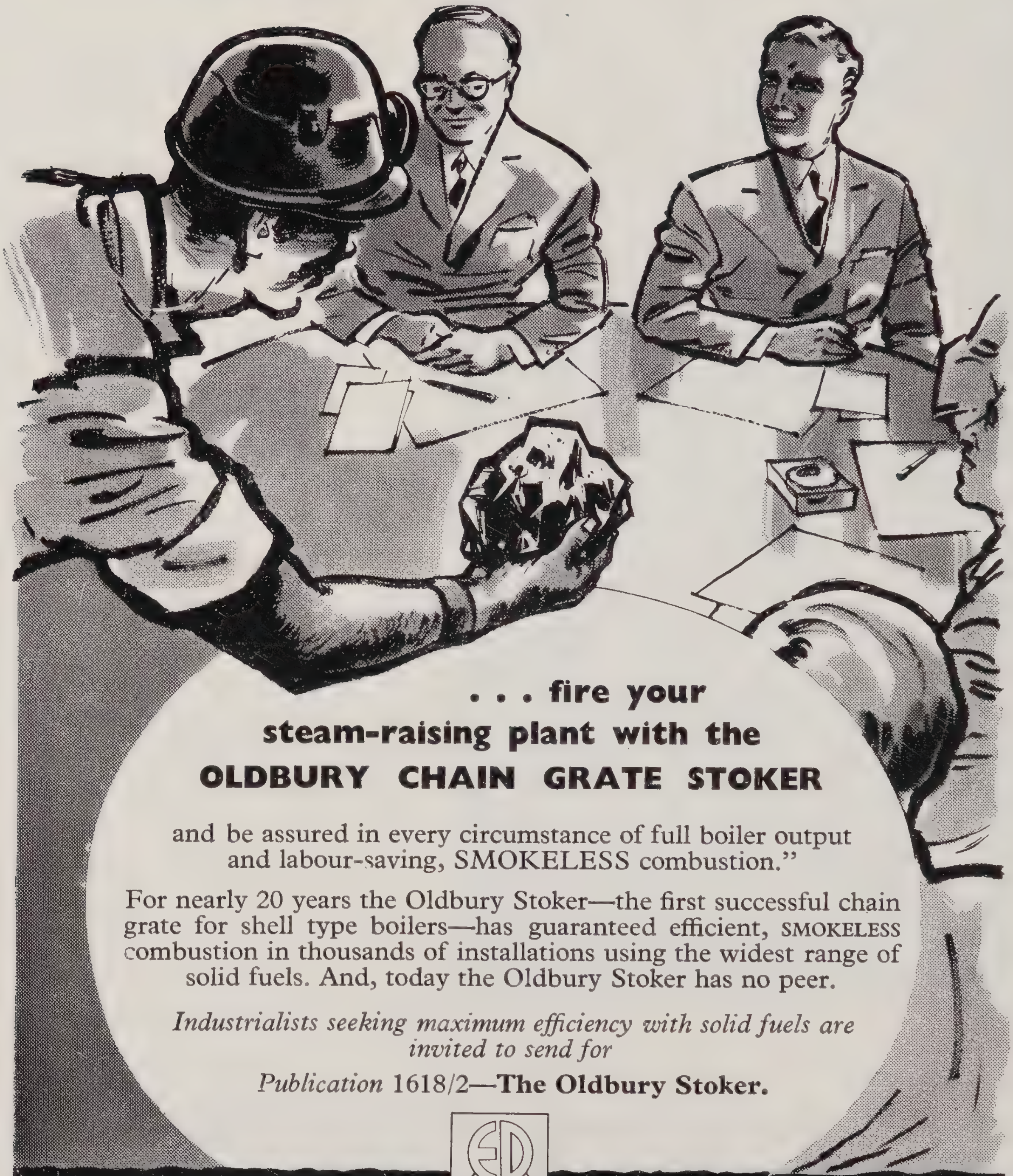

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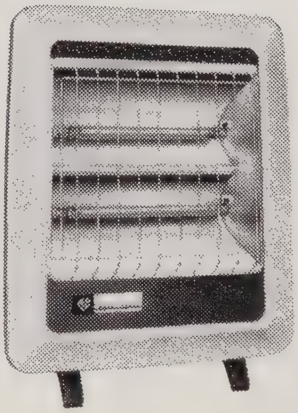

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National Society for Clean Air

29th Annual Conference and Exhibition
Harrogate 1962

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A Welcome from the Mayor

My colleagues and I are delighted to know that the National Society for Clean Air has decided to hold its Conference in Harrogate again this autumn. We were more than pleased to welcome you in 1960 and it is most gratifying to have this return visit, particularly as we feel we can welcome old friends.

We are naturally proud of the facilities which we are able to offer for Conferences and we are happy that you are able to take full advantage of our unique Exhibition Hall. The efforts of your Society to prevent the danger to health from lack of clean and pure air are very much to be commended and we in Harrogate are constantly vigilant to see that our lovely town is not polluted through any human agency.

I would like to offer you a very warm welcome to the town once again. I look forward to meeting you some time during the Conference and wish you an enjoyable time during your stay.

Yours sincerely,
NORMAN MORRELL,
Mayor.

The Mayor's Parlour,
Harrogate.

Notes on the Conference

TO meet again in Harrogate, after a gap of only one year, changes the pattern of the Society's conference habits, especially when another visit is planned for 1964 (Next year, please note—Scarborough). The reasons for choosing Harrogate so frequently are simple—it provides exhibition space of just the kind we need, in a single hall that adjoins the excellent theatre in which the conference is held. Add to this the helpful co-operation and friendly hospitality given by the local authority—and the town too—and it becomes difficult to give Harrogate a miss.

* * *

The big organizational difficulty with which we are increasingly faced is to hold the conference at a time that does not clash with other conferences, the number of which seems continually to grow. This year we have been unable to avoid others in which at least some of our members are interested, and in particular there is the Conservative Party conference on at the same time at Llandudno. Lord Jellicoe, as Parliamentary Secretary to the Ministry of Housing and Local Government was to have opened our conference, but the recent Government changes have transferred him to another sphere, and unfortunately both the new Minister and the new P.S., Mr. Corfield, are committed to North Wales.

* * *

Last year, at Brighton, the conference continued during the Friday afternoon: an experiment that was not altogether successful. Still faced with a demand for (*a*) more time and (*b*) more technical discussion, we are this year holding a special "pre-conference" technical session. The subject is pollution problems in the iron and steel industry. All conference delegates are of course entitled to attend, and it is hoped that they will do so, despite the earlier arrival required, and in addition we are inviting, as guests for this one session, members of interested organizations such as the Iron and Steel Institute and the Institute of Fuel.

* * *

The conference programme itself will be found in detail on later pages. The papers to be presented will be of wide interest, importance and practical value, and there should be good discussions.

* * *

On the Thursday afternoon for the questions and answers session on domestic smoke problems, with a first-class platform panel, members of women's organizations from a wide area are being invited to attend as guests and also to visit the Exhibition.

* * *

On the Exhibition it need only be said that it is larger than any of the Society's previous exhibitions, and we are confident that it will more than maintain the high standards of presentation that this event has achieved.

* * *

Finally, on the social side, do not fail to look in and meet (or make) friends at the informal—no programme—"get together" on the Tuesday evening. On the Wednesday evening there will be a Civic Reception which, if it is as enjoyable as that in 1960, will be very good indeed.

Yorkshire and Clean Air

and Progress Reviewed

by

A Yorkshire Contributor

HARROGATE is a good Conference centre for the National Society for Clean Air because it is adjacent to the heavy industrial areas which comprise the "black" areas of the North and the Midlands. In the past, in this part of the country, a smoking chimney was regarded as an indication of prosperity. "Where there's muck there's brass" used to be a common saying indicating the mentality of persons who saw no wrong in a dirty atmosphere. This attitude is now changing for no longer does the community accept that soot, ash, grit and gritty particles are a necessary accompaniment to prosperity.

Some of the credit for the changing public attitude is due to the activities of two local organizations, firstly, the West Riding Clean Air Advisory Council, first set up in 1955 as a result of a Conference for Local Authorities in the West Riding of Yorkshire.

One of the prime movers in the setting up of this Regional Committee was Dr. J. Johnstone Jervis, then Medical Officer of Health for Leeds, who became the first Honorary Secretary, in which office he was followed by Professor I. G. Davies and then by Professor D. B. Bradshaw, the present Honorary Secretary. The Chairman of the West Riding Clean Air Advisory Council is Mr. E. J. Winfield, Senior Public Health Inspector of Castleford.

The Yorkshire Divisional Council of the National Society for Clean Air has also played an important part in moulding local public opinion. This Council was established in 1947 under the Chairmanship of Mr. T. Henry Turner, an individual member from British Railways, who was succeeded in office by Mr. J. H. Beaumont of Halifax, then by Mr. J. Law of Sheffield, the present Chairman being Mr. A. C. Saword of Kingston-upon-Hull.

The present public demand for clean air shows itself in our cities in many ways, including the number of buildings being washed externally, and a new fashion in decoration, such as the pastel shades replacing the dark browns of the past; the increasing number of flower beds on traffic islands, and other indications to bring light and brightness into our polluted cities. The public are now demanding rapid Clean Air progress.

PROGRESS REVIEWED

In order to consider what progress has been made, and what further progress can be made in the future, we must consider today's position along with the recorded pollution of the past.

Domestic Premises

In 1953, as recorded in the Beaver Report, 36·8 million tons of coal were consumed for domestic purposes and resulted in 0·9 million tons of smoke, 0·1 million tons of grit and dust, and 0·9 million tons of sulphur dioxide being discharged into the atmosphere. (More recent research puts the smoke emission at a higher level, and the latest estimates, for 1960, give 1·1 million tons emitted from domestic sources*). The trend now is for occupiers of houses to depend more on electricity and solid smokeless fuel and town gas for space heating. The

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* See Clean Air Year Book, 1962–3, page 39.

Aysgarth Falls, Wensleydale

amount of coal burnt in domestic premises had fallen by 2·3 million tons in the period 1953 to 1960, *i.e.* from 36·8 to 34·5 million tons. The fall is not impressive but should increase more rapidly during the next decade, leaving only a fractional figure of green coal consumed in domestic premises. Before too many years have passed the coal merchant will have become the solid smokeless fuel merchant.

It will be realized that some improvement in atmospheric pollution figures can be expected even at this early stage. Future progress will depend on increased production of all types of solid smokeless fuel. Advancement will be helped by the success of the National Coal Board producing in quantity the new types of high reactivity smokeless fuels on which they have been working for some time. At the moment a pilot scheme has been in operation at Birch Coppice in the West Midlands carrying out trials on briquette manufacture, and sufficient faith has been placed in the basic process to justify beginning design work for a commercial scale plant. Simultaneously work is in a similar stage of advancement on a further process proved at Craigola, S. Wales, for producing smokeless briquettes. The hard coke known as "Sunbrite" which is produced by the N.C.B. is in plentiful supply, however, and its use in closed stoves might well be encouraged to free more reactive fuels for the open fire.

Gas Works

In 1953 27·2 million tons of coal were consumed in gasworks, which in some places resulted in serious local nuisance of smoke, dust and grit plus 0·2 million tons of sulphur dioxide released into the atmosphere. In 1960 the N.C.B. sold 22·3 million tons of coal to the Gas Boards, which reflects increased efficiency and perhaps the trend of the latter's policy to depend more on oil and now natural gas from North Africa. Among the objects of the Gas Boards is to supply a non-toxic gas of high calorific value and to capture a much larger market for gas than exists at present. Many improvements in gas manufacture have taken place in recent years, for example, the Lurgi process of complete gasification of coal has become operational. Carburreted water gas plants have increased in number, as have continuous vertical retorts, and two years should see the end of the offensive horizontal retorts.

Railways

In 1953 13·8 million tons of coal was consumed by railways and resulted in 0·3 million tons of smoke, 0·1 million tons of grit and dust, and 0·4 million tons of sulphur dioxide being discharged to atmosphere. In 1960 the N.C.B. sold 8·9 million tons of coal to the railways, a reduction of 4·9 million tons. The consumption of fuel by the railways has fallen slightly since 1953 and the use of diesel oil and electricity have to a considerable extent replaced the use of coal. The Transport Commission have a programme which will ultimately result in the disappearance of the inefficient steam locomotive and the accompanying smoke, grit and dust nuisance. It would seem that this particular source of pollution has to some extent already been reduced and will progressively become less acute.

Electricity Works

In 1953 coal consumption was 36·7 million tons and the pollution from power stations was 0·3 million tons of dust and grit, 1·0 million tons of sulphur dioxide and what was described as a small amount of smoke. In 1960 the Board's power stations used 51·1 million tons of coal and 5½ million tons of oil, which represents a considerable increase of 14 per cent. Hydro and nuclear electricity production has increased from the equivalent of 1 million tons of coal in 1953 to the equivalent of 2·7 million tons in 1960. The consumption of electricity in the home has approximately doubled itself in the period 1953 to 1961. Power stations have become more efficient, working at an average thermal efficiency for all stations of 26·7 per cent. in 1960.

Fuel & Diesel Oil

In 1953 9·0 million tons of fuel and diesel oil were consumed and resulted in 0·4 million tons of sulphur dioxide, being discharged into the atmosphere. Figures for 1960 show that 36·6 million tons of these oils were consumed. From this it may be assumed that pollution from this source will have increased considerably. However, due consideration should be given to the facts that oil has a higher calorific value and is usually burnt at higher thermal efficiency than the coal which it may have replaced. Therefore, less oil tonnage is required to produce the same power as the original coal, also there are no grit troubles and smoke is not often caused (especially with the progress made in burner design since 1953 which makes possible continuous automatic operation with a turn down ratio in excess of 12–1.) Since 1953 the oil industry has conducted experiments, particularly on metal stacks, to prevent smut emissions, and now claim complete control over this problem.

Industry and Miscellaneous

In 1953 64·6 million tons of coal were consumed by industry and resulted in the following pollution: 0·8 million tons of smoke, 0·3 million tons of dust and grit, and 1·8 million tons of sulphur dioxide. In 1960 this figure would appear to have fallen to 48·7 million tons and shows the trend of the industrial consumer to employ other fuels such as fuel oil, sales of which have more than trebled to the industrial consumer in the period 1953 to 1960, and electricity, sales of which have increased by 68 per cent. in a similar period. For some time now an intense commercial battle has raged between the suppliers of the

Montpelier Parade, Harrogate

various types of fuel. Each industry has devised schemes by which the industrialist (and domestic consumer) may call for technical advice and financial assistance in an endeavour to capture or retain business. This competition has helped the cause of clean air to a marked degree. The extent to which pollution from this source has been reduced is difficult to assess but there can be no doubt that improvement has occurred and will continue, particularly after expiry in July 1963 of the defence against the Dark Smoke (Permitted Periods) Regulations, 1958 contained in Section 2 of the Clean Air Act, 1956.

Coke Ovens

Little change is apparent in this industry, conditions being much the same as in 1953 when 25·9 million tons of coal was consumed as opposed to 28·5 million tons in 1960.

Conclusion

The next decade will witness the problem of smoke, dust and grit largely solved, remaining will be the difficult problem (which tends to worsen each year) of sulphur dioxide and CO emissions. British coal has a relatively low sulphur content, averaging 2·5 per cent. and only a portion of this is discharged to the atmosphere, the remainder being left in the ash. On the other hand, fuel oil may contain 4 per cent. sulphur in the case of the heavier oils, all of which is discharged to atmosphere, although as mentioned above, less tonnage is required. Therefore, if the demand for fuel oil increases, the sulphur problem may worsen, and the question of chimney heights becomes more important.

Thirty Years On

It may be of rather more than passing interest to recall that thirty years ago, in October, 1932, the Society met a little further north than Harrogate—at Newcastle upon Tyne. The growth of the movement since that time is shown by the growth in the numbers attending, from about 100 to nearly 1,000 today, and by the very different kind of programme then arranged.

The conference assembled on a Friday evening with a civic reception at the Laing Art Gallery, at which Dr. Des Voeux read a typically lively and stimulating address. He contrasted conditions in the place in which he lived, Lymington, with a city like Newcastle, and he also stressed the importance of an aspect of air pollution that has been oddly neglected, and which may again come up for discussion at the present conference—the danger of carbon monoxide from the exhausts of motor cars. The President's concluding words may be quoted:

> "Remember you can be deprived of water three days, of food three weeks, and still survive; but you breathe into your system your draught of air sixteen times every minute, and although you spend large sums of money in securing the purity of your food and water, you breathe your polluted air with little or no complaint. And yet you will be offended if I call you uncivilized, and therefore I shall not venture to do so; but will content myself by telling you that it was a Chinaman who said it to me!"

On Saturday morning there was one paper, on the possibilities of coke oven fuel for domestic purposes, by R. A. Mott. It was an excellent review, with constructive suggestions and foreshadowed the popular "Sunbrite" of today, and in which we find listed a surprising number of open grates then on the market specially designed for smokeless fuels.

The morning session over, delegates were taken as guests of the Corporation on a tour to the Roman Wall, with lunch and tea, and a fascinating visit to Housteads. That was a privilege of a small conference which cannot be expected for a thousand.

Another session, the last, took place on Sunday morning, when two papers were presented: one on the Psychological Effects of Air Pollution, by Alderman David Adams of Newcastle, and the other by the Senior Smoke Inspector of Manchester, Mr. A. E. Crossley, on "The Human Element"—a practical paper largely concerned with the problem of the stokers responsible for the then much more common hand-firing of boilers.

The conference, in distant retrospect, seem rather slight, but it was compact and intimate, and was stimulating to the relatively few who were so patiently preparing the ground for the growth and progress that was to come.

National Society for Clean Air

formerly the

National Smoke Abatement Society

Present and Past Officers, etc.

President: The Rt. Hon. Lord Cohen of Birkenhead.

Immediate Past-President: Sir Hugh Beaver, K.B.E.

Past Presidents: Dr. H. A. Des Voeux*, Will Melland*, Sir George Elliston*, Lord Simon of Wythenshawe*, Dame Vera Laughton Mathews, D.B.E.*, Alderman Professor F. E. Tylecote, C.B.E., Sir Ernest Smith, C.B.E.*, Dr. R. Lessing, C.B.E. (**Deceased.*)

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Deputy Chairmen: James Goodfellow, T. Henry Turner.

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Chairmen of Committees

Conference: J. J. Matthews.

General Purposes and Finance: Dr. J. L. Burn.

Parliamentary and Local Government: E. M. Birtwistle.

Publicity: Miss M. George, M.B.E.

Technical: Dr. J. S. G. Burnett.

Standing Counsel: W. R. Hornby Steer.

Hon. Solicitors: Messrs. Bell, Brodrick and Gray.

Hon. Auditors: Messrs. Geo. Little, Sebire & Co.

Bankers: The District Bank Ltd.

Divisional Councils: Chairmen and Secretaries

Scottish: John Innes, M.B.E. (*President*), John W. Traill.

Northern Ireland: Councillor Miss I. M. McAlery, W. E. C. O'Brien.

North West: J. W. Rodgers, R. J. Stanyard.

North East: Alderman B. N. Young, L. Mair.

Yorkshire: A. C. Saword, James Goodfellow.

West Midlands: Councillor F. V. Magness, W. L. Kay.

East Midlands: G. Drabble, A. Wade, M.B.E.

South East: W. Combey, J. J. Matthews.

South Wales and Monmouthshire: Alderman Dr. C. A. Bence, J. A. Church.

Headquarters Staff:

Director, Secretary and Editor: Arnold Marsh, O.B.E.

Administrative Secretary and Exhibitions Officer: Roy J. Sharp.

Information Officer and Librarian: Mrs. V. Finlay.

Accountant: Mrs. D. M. Wolfe.

Secretarial Assistants: Mrs. M. H. Mellins, Miss B. Bull, Miss A. Roberts, Miss J. Negus, Miss G. Kosky.

For New Delegates

ABOUT THE SOCIETY

Those who are attending the Conference for the first time may wish to know more about the National Society for Clean Air. As we celebrated our Diamond Jubilee in 1959 with a special International Conference it will be seen that the Society has quite a long history. Starting in a very small way with but a handful of private individuals, the Coal Smoke Abatement Society was formed in 1899. It did valuable pioneering work and accomplished the first necessary stage of making it understood that clean air was not the impractical fad of a few cranks. It did much behind the scenes when the Newton Committee was set up, and co-operated with a provincial association that had been formed in 1909, the Smoke Abatement League of Great Britain. In 1929 the two bodies joined together to form the National Smoke Abatement Society.

This name was retained until 1958, when it was changed to the present one, and at the same time, to put its membership and finances on a recognized business footing, it became a Company Limited by Guarantee and not having a share capital. It is licensed by the Board of Trade to omit the word "Limited" from its name and for Income Tax purposes it is recognized by the Board of Inland Revenue as a Charity.

The Society is a voluntary organization essentially subsisting on the subscriptions of its members, and it does not receive any official grant or subsidy. Its members include individuals, local authorities and firms, associations and other corporate bodies. Although local authorities—over 500—constitute the largest class of membership the corporate members make the largest class of subscriptions. The Society is governed by an Executive Council consisting partly of elected representatives of members on a divisional basis, and partly of the appointed representatives of national organizations in membership. The Divisions are Scotland, North West, North East, Yorkshire, West Midlands, East Midlands, South East, South Wales and Monmouthshire, South West and Northern Ireland. There are Divisional Councils of members, with their own committees and honorary officers, in each of the Divisions except the South West.

The Society's objects are, in brief, to promote clean air by education, publicity and similar means, to encourage the adoption of means for clean air, and generally to help to create a public opinion in favour of these objects. Its main activities are the publication of a journal, Year Book and other literature, the holding of conferences and meetings, providing educational and publicity material, information and other services, and co-operating with others.

The Society and its parent bodies have many achievements to their credit, from pioneering the training of boilerhouse firemen and the regular measurement of air pollution to the conception and advocacy of smokeless zones and prior approval.

Today, with the new Act in force, the opportunities for useful activity by the Society are greater than ever before, and are in fact both needed and demanded more than ever before. But much remains undone because its income is only a tithe of what could be used to advantage. New members, and more new members, are needed—and if you, as a delegate to this conference, can help us to secure them you will be doing a very good turn to the cause of clean air.

Platform Who's Who

Brasser, L. J. Deputy Head of Air Pollution Division, Institute of Sanitary Engineering, T.N.O., Netherlands.

Burn, J. L., M.D., D.Hy., D.P.H. Medical Officer of Health, Salford; Chairman of Executive Council, N.S.C.A.

Carter, Dr. J. S., C.B.E., Ph.D., M.Sc., F.R.I.C., M.Inst.F. Chief Inspector of Alkali &c., Works, Ministry of Housing and Local Government.

Cayton, S., F.R.S.H., M.A.P.H.I., M.Inst.F., M.Inst.P.C. Chief Public Health Inspector and Cleansing Superintendent, West Bromwich; Member of Executive Council, N.S.C.A.

Charlton, Mrs. D. M., O.B.E., B.Sc. Chairman, Women's Advisory Council for Solid Fuel; Member of the Clean Air Council and Executive Council, N.S.C.A.

Cohen, the Rt. Hon. Lord, of Birkenhead. President, N.S.C.A.; Professor of Medicine, University of Liverpool; Chairman, Central Health Services Council, Ministry of Health; Member of Clean Air Council; President, Royal Society of Health.

Cooper, R. L., M.Sc., Ph.D., F.R.I.C. Principal Scientific Officer, The British Coke Research Association, Chesterfield.

Dawson, F. E., F.A.P.H.I., M.Inst.P.C. Superintendent Health Inspector, Department of Health, Irish Republic. Advisor to Department of Local Government, Irish Republic on atmospheric pollution investigation and control.

Draper, P., M.I.Mech.E., M.Inst.Fuel. Consultant. (Formerly of Technical Dept., Shell-Mex and B.P. Ltd.).

Goodfellow, James, F.R.S.H., M.I.P.H.E. Chief Public Health Inspector, Leeds; Joint Deputy Chairman of Executive Council, N.S.C.A.; Hon. Secretary, Yorkshire Division, N.S.C.A.

Graham, J. P., B.Sc., F.Inst.F. Assistant Director (General), The British Coke Research Association, Chesterfield.

Guthmann, Dr.-Ing. Kurt. VDI Clean Air Commission, Düsseldorf, Western Germany.

Hacking, R. A., O.B.E., M.Sc., F.I.M., F.I.Ceram. Director of Research, Richard Thomas and Baldwins Ltd. Member of the Clean Air Council and Executive Council, N.S.C.A.

Hudson, N., M.B.E., M.Inst.Gas E. Representing the Gas Council. Commercial Manager, North Eastern Gas Board.

Joosting, Dr. P. E. Medical Adviser, Institute of Sanitary Engineering T.N.O., Netherlands.

Lawther, Dr. Patrick J., M.R.C.P. Director, Medical Research Council, Air Pollution Research Unit, and Consultant in Environmental Medicine, (St. Bartholomew's Hospital).

Levantal, Georges. Barrister. General Delegate of the Association for the Prevention of Atmospheric Pollution of France. Vice-President, French Institute for Industrial Design.

Maddocks, D. N. Representing the Coke Department of the Gas Council; Coke Manager, West Midlands Gas Board.

McKinnell, W. J. S. Manager, Sales Planning Branch, National Coal Board.

Miller, Dr. M. S., J.P. Member, Glasgow City Council, Chairman of Sub-Committee on Smoke Control Areas.

Morrell, Councillor G. Norman M., J.P., N.D.A., N.D.D. Mayor of Harrogate. (See page 22).

O'Brien, W. E. C. Div. Public Health Inspector, Castlereagh R.D.C., Hon. Sec. N. Ireland Division, N.S.C.A.

Partington, R. B. Technical Officer, British Electrical Development Association.

Robinson, F. A., F.C.C.S. Director of Hargreaves Group Ltd.

Saword, A. C., D.P.A., F.R.S.H., F.A.P.H.I. Chief Public Health Inspector, Kingston upon Hull. Member of Executive Council, N.S.C.A., and Chairman, Yorkshire Divisional Council.

Shaw, F. M., A.M.I.Mech.E. Foundry Atmospheres Section, British Cast Iron Research Association.

Turner, T. Henry, M.Sc., M.I.Mech.E., M.I.Loco.Eng., F.I.M. Individual Member, Deputy Chairman, N.S.C.A.

Wood, A. H., B.Sc. Head of Technical and Development Department, British Iron and Steel Federation.

Conference Information

Meeting Place

All Conference sessions and social events will be held in the Royal Hall, Harrogate.

Registration

A Registration Card will be enclosed with this Handbook, and you are requested to complete this and hand it in at the Society's Information Desk, or to a Steward, at the first session attended.

Discussions

Those wishing to speak in the discussions should complete and hand in a printed Discussion Card which may be obtained from the Society's stand or Steward in the hall. All speakers are requested to: (*a*) condense their remarks as much as possible, and (*b*) confine them to the specific questions raised in the papers being discussed. The time allowed for contributions will normally be limited to three minutes. Those who take part in the discussions and wish to have their remarks recorded are asked to send a condensed copy of their remarks, in reported speech, to the Director not later than October 17th.

Resolutions

The following conditions for the submission of resolution are stipulated by the Executive Council:

(*a*) Any resolution it is desired to submit must be relevant to matters under discussion at the conference.

(*b*) No resolution may be moved except by prior approval of the Resolutions Committee.

(*c*) A copy of the proposed resolution must be received by the Director not later than 10.30 a.m. on Wednesday, October 10th, or preferably by post (at the Society's offices) on or before October 5th.

(*d*) Resolutions will be moved at the end of the Friday morning session only.

List of Delegates

A printed list of delegates will be available at the Society's stand in the Exhibition.

Proceedings

All the Papers, Addresses, discussions and any resolutions adopted will be published in volume form as the *Proceedings* of the Conference. A copy will be forwarded free of charge to all registered delegates and extra copies will be available at about 25s. each.

The Exhibition

The Clean Air, Fuel Efficiency and Domestic Heating Exhibition, organized by the Society in conjunction with the Conference will be held in the Exhibition Hall, adjoining the Royal Hall. The Exhibition will be open to delegates and to others by invitation ticket. For hours of opening, see page 39.

Bookstall

There will be a bookstall of the Society's, H.M. Stationery Office and other publications as a part of the Society's Stand in the Exhibition.

Bank Facilities

Full banking facilities will be available to all attending the Conference or Exhibition, from the District Bank Ltd., at Stand A.11 in the Exhibition.

Rail Travel

Inquiries about rail travel, seat reservations, etc., may be made at the British Railways Bureau, in the Exhibition. (Stand No. D.9).

Delegates will be receiving a B.R. Conference Travel Voucher, which will enable them to obtain tickets at a special concessionary rate.

General Inquiries

The Society's staff at the Conference Office (see Exhibition plan) will be pleased to assist with any inquiries on matters not mentioned above.

SOME N.S.C.A. PUBLICATIONS

Available at the Society's Stand

CONFERENCES:

International, 1959 (Diamond Jubilee) (*Special Price*)	10s.
Harrogate, 1960	25s.
Brighton, 1961	15s.

EVELYN:

John Evelyn's famous "Invective" on "The Smoake of London Dissipated" (1661) The Society's Tercentenary Edition

Cloth-bound	5s.
Paper-back	2s. 6d.

PUBLICITY:

N.S.C.A. Publicity Advisory Service: Catalogue of Exhibits, Posters, Leaflets, etc.	*Gratis*

LEAFLETS:

Single copies gratis

"They Didn't Know what to do"	£1 10s. per 1,000
"Facts about Smoke"	£6 10s. per 1,000
"Clean Air Begins at Home" (New)	£6 per 1,000

Programme

of the

Conference

All sessions, the Informal Gathering and the Civic Reception will be held in the Royal Hall

For details of Authors, Speakers, etc., see " Platform Who's Who ", page 31

Tuesday, 9th October

Afternoon

3.30 (to 5.30) Preview of Exhibition.

4.00 N.S.C.A. Extraordinary General Meeting. (*Open only to Members and appointed Representatives of Members who have received a formal notice which serves as an admission ticket*).

4.30 Pre-Conference Technical Session.

Air Pollution Problems in the Iron and Steel Industry.

Chairman: R. A. Hacking, O.B.E.

Papers:

Some Aspects of Air Pollution Control in the Steel Industry, by A. H. Wood.

Mitigation of Air Pollution at Coking Plants, by R. L. Cooper and J. P. Graham.

Air Pollution from Iron Foundry Cupolas, by F. M. Shaw.

6.30 approx. Close of session.

Tuesday, 9th October—*continued*

Evening

From **8.30** Informal Gathering

Wednesday, 10th October

Morning

9.30 Exhibition opens.

10.30 **Opening Session**

Chairman: The President, the Rt. Hon. Lord Cohen of Birkenhead

Civic Welcome by the Worshipful the Mayor of Harrogate, Councillor G. Norman M. Morrell, J.P.

The Presidential Address.

12.00 approx. Lunch adjournment.

Afternoon

Chairman: Dr. J. L. Burn

2.30 **International Session**

Presentation of Papers and Reports:—

France: by G. Levantal.

Republic of Ireland: by F. E. Dawson.

The Netherlands: by L. J. Brasser and Dr. P. E. Joosting.

West Germany: (i) by the VDI Clean Air Commission.
(ii) by Dr.-Ing. K. Guthmann.

United Kingdom: Verbal Reports on Medical Research Progress by Dr. P. J. Lawther and on Northern Ireland by W. E. C. O'Brien.

Discussion.

Wednesday, 10th October—*continued*

4.30 approx. Close of session.

6.30 Exhibition closes.

Evening

8.30 Civic Reception, *by invitation.*

Thursday, 11th October

Morning

9.30 Exhibition opens.

Chairman: James Goodfellow

10.00 **The Alkali Works Order, 1958.** Paper by Dr. J. S. Carter, C.B.E.

Discussion.

12.30 approx. Lunch adjournment.

Afternoon

2.30 **Domestic Smoke: Smoke Control Areas and Domestic Heating.** Questions and Answers.

Chairman: Mrs. D. M. Charlton, O.B.E.

Panel: P. Draper
N. Hudson, M.B.E.
D. N. Maddocks
W. J. S. McKinnell
Cllr. Dr. M. S. Miller, J.P.
R. B. Partington
F. A. Robinson
A. C. Saword

Questions from members of the Conference, preferably sent in beforehand, on *domestic* problems, are invited.

4.30 approx. Close of session.

5.30 Exhibition closes.

Friday, 12th October

Morning

9.30 Exhibition opens.

Chairman: T. Henry Turner

10.00 Incineration and Waste Disposal. Paper by S. Cayton. Discussion.

12.00 Any resolutions; votes of thanks.

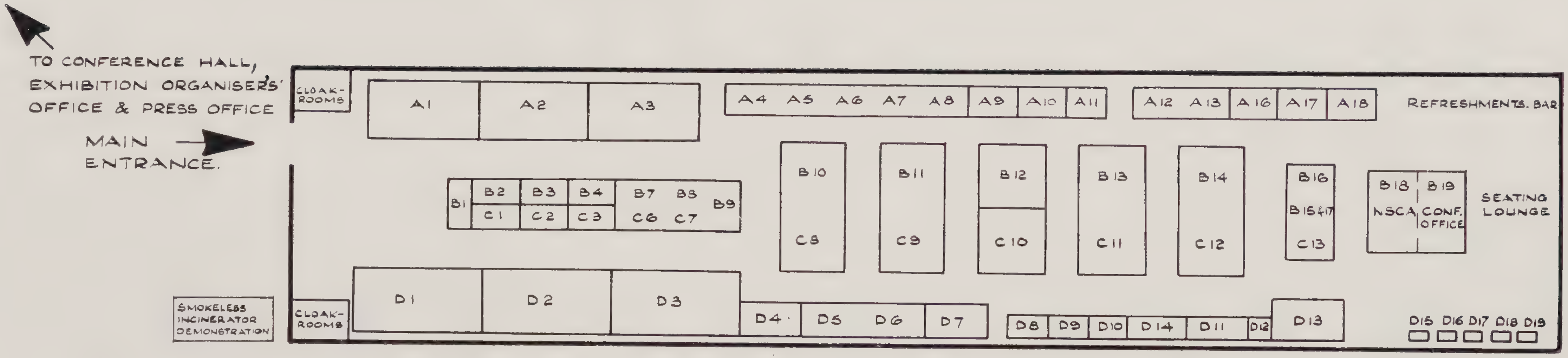
12.30 Close of Conference.

1.00 Close of Exhibition.

Previous Conferences of the Society

1929	Buxton
1930	Leicester
1931	Liverpool
1932	Newcastle upon Tyne
1933	Sheffield
1934	Glasgow
1935	Bristol
1936	London (Science Museum)
1937	Leeds
1938	Cardiff
1943	London*
1945	London*
1946	Brighton*
1947	Edinburgh*
1948	Cheltenham*
1949	Harrogate*
1950	Margate*
1951	Blackpool
1952	Portsmouth*
1953	Glasgow*
1954	Scarborough*
1955	Bournemouth
1956	Southport*
1957	Hastings*
1958	Llandudno*
1959	London (Diamond Jubilee International)*
1960	Harrogate*
1961	Brighton*

** Proceedings still available. For prices and other details see current Clean Air Year Book.*



EXHIBITION PLAN AND KEY TO STANDS

Stand No.	*Exhibitor*
A.1	Shell-Mex and B.P. Ltd.
A.2	National Carbonising Co. Ltd.
A.3, B.10 & C.8	Gas Council.
A.4-A.8	Coal Utilisation Council.
A.9	Carron Company.
A.10	Tilghman's Ltd.
A.11	District Bank Ltd.
A.12-A.13	Lodge-Cottrell Ltd.
A.16	Collectron Ltd.
A.17	Thomas Potterton Ltd.
A.18	Women's Advisory Council on Solid Fuel.
B.1	Combustion Equipment Ltd.
B.2	Hargreaves (West Riding) Ltd.
B.3	Simplex Electric Co. Ltd.
B.4	National Industrial Fuel Efficiency Service.
B.7-B.9 & C.6-C.7	James Howden & Co. Ltd.
B.11 & C.9	British Electrical Development Association.
B.12	Department of Scientific & Industrial Research.
B.13, C.11	Central Electricity Generating Board.
B.14, C.12	Ministry of Housing & Local Government.
B.15-B.17 & C.13	Head, Wrightson & Co. Ltd.
B.18-B.19	National Society for Clean Air.
C.1	Boston Marine & General Engineering Co. Ltd.
C.2	Lawden Manufacturing Co. Ltd.
C.3	James Gordon & Co. Ltd.
C.10	Morphy-Richards Ltd.
D.1	Coalite & Chemical Products Ltd.
D.2	National Coal Board.
D.3	Solid Smokeless Fuels Federation.
D.4	Cannon (G.A.) Ltd.
D.5-D.6	Ambuco Ltd.
D.7	Maywick Appliances Ltd.
D.8	British Coking Industry Association.
D.9	British Transport Commission.
D.10	The West Riding Clean Air Advisory Council.
D.11	Falk Stadelmann & Co. Ltd.
D.12	Saniguard Appliances Ltd.
D.13	Lion Stamping Co. Ltd.
D.14	Pergamon Press Ltd.
D.15	Pyramid Press Ltd.
D.16	The Municipal Journal Group.
D.17	Arrow Press Ltd.
D.18	Best Products Ltd.
D.19	Charles Knight & Co. Ltd.
D.20	Pionex Ltd.
Smokeless Incinerator Demonstrations	Boston Marine & General Engineering Co. Ltd. Maywick Appliances Ltd.

CLEAN AIR
FUEL EFFICIENCY AND
DOMESTIC HEATING
EXHIBITION

CATALOGUE

THE EXHIBITION HALL
HARROGATE
9th—12th OCTOBER, 1962

Hours of opening:
(*Preview*) Tuesday, 9th October — 3.30 p.m. to 5.30 p.m.
Wednesday, 10th October — 9.30 a.m. to 6.30 p.m.
Thursday, 11th October — 9.30 a.m. to 5.30 p.m.
Friday, 12th October — 9.30 a.m. to 1.00 p.m.

EXHIBITORS AND DESCRIPTION OF EXHIBITS

The information given in this list has been supplied by the Exhibitors and no responsibility for any of the statements or descriptions can be accepted by the National Society for Clean Air.

Stand No.

D5 and D6 **AMBUCO LIMITED—(A Member of The Gold Fields Mining and Industrial Group), 49 Moorgate, London, E.C.2. (Telephone: METropolitan 9242).**

Ambuco Limited are specialists in the design and construction of systems for fumes and gas cleaning and for the collection of fine particulate matter. Their stand features working models of two of the processes employed which have special connections with clean air requirements.

Ambuco "Guaranteed Efficiency" Cyclones

Ambuco cyclones have many applications including that of flyash collection, but the one most widely used is for the recovery of catalyst in oil refineries and also for the collection of fine particles in chemical manufacture.

Ambuco Venturi Scrubbers

Ambuco venturi scrubbers employ a unique double-scrubbing process whereby fumes containing sub-micron particles of solid matter are caused to pass through a double cone water spray. This method ensures extremely efficient fume cleaning with removal efficiencies as high as 99·8 per cent.

The unique method employed by Ambuco venturi scrubbers ensures that any plant employing them will be within the requirements of the Clean Air Act regarding the release of particulate matter into the atmosphere.

Other Equipment

Ambuco manufacture and install a wide range of dust control equipment including fabric arresters and medium efficiency low loss flyash collectors.

D18 **BEST PRODUCTS LTD., Ranelagh House, Felixstowe, Suffolk. Tel: Felixstowe 1554.**

Displayed for the first time at any Clean Air Conference is the new, revolutionary "MATCHLESS" ELECTRIC FIRE-LIGHTER. Guaranteed to ignite every known fuel, this appliance has the latest refractory enabling heat at 800°C. to be produced at the nozzle *without* the need to bury within the fuel; thus repeated change of nozzles due to erosion and burn-out is avoided.

NOW LET'S CLEAN IT UP!

Dust and smoke both mean trouble. They may mean that the requirements of the Clean Air or Alkali Acts are being contravened. They may also mean that a valuable product is going to waste. Ambuco specialize exclusively in dust control. Because of their experience in the application of scrubbers, cyclones and fabric arresters to the chemical, petroleum, and iron and steel industries, Ambuco can provide a system which meets both your technical *and* commercial requirements. Ambuco installations can be guaranteed to meet the Clean Air and Alkali Acts or other local requirements. If you feel that Ambuco may be able to help 'put dust in its place' in *your* organisation, we shall be happy to supply all the information you may require.

AMBUCO

PUT DUST IN ITS PLACE!

AMBUCO LIMITED · 49 MOORGATE · LONDON E.C.2

A MEMBER OF THE GOLD FIELDS MINING & INDUSTRIAL GROUP

INSTALL
THE COMPLETELY
SMOKELESS
INCINERATOR
-THE "HOSKINSON"

because IT—

- Burns all combustible materials without any smoke or odour—and this means rubber, plastics, animal matter, etc.
- Burns faster than any other incinerator
- Applies to Markets, Hospitals, all Industrial Premises, Large Stores, etc.
- Is inexpensive, portable and easy to install
- IS GUARANTEED TO DO ALL WE CLAIM

SEE A
PRACTICAL DEMONSTRATION
OUTSIDE THE
EXHIBITION HALL

BOSTON MARINE & GENERAL ENGINEERING CO. LTD.
Dept. C.A.C., Heath Town Works, Wolverhampton, Staffs.
Telephone: 25125-6-7

Operating from a 5-amp plug, firelighting cost is at a minimum. A removable key makes the switch " Infant Safety " while a red neon light gives " Adult " warning that the element is operating.

Height adjustment of the stand is achieved in seconds and the easy " tuck away " position facilitates hanging or standing after use.

Designed with feminine appeal, the " MATCHLESS " FIRE-LIGHTER is in mottled brown with plated nozzle and stand. With it goes an after-sales service that is simplicity itself.

This appliance was approved by British Electrical Development Association in May 1962.

CAT. No. FL/1. Price £4 19s. 6d. plus 18/3 Tax.

C1 and outside main entrance

BOSTON MARINE & GENERAL ENGINEERING CO. LTD., Heath Town Works, Deans Road, Wolverhampton. Telephone: 25125 Telegrams: BOSMARCO

The company will be exhibiting a working model of the B.200 Smokeless Incinerator which will demonstrate the burning of rubber and other difficult materials entirely smokelessly.

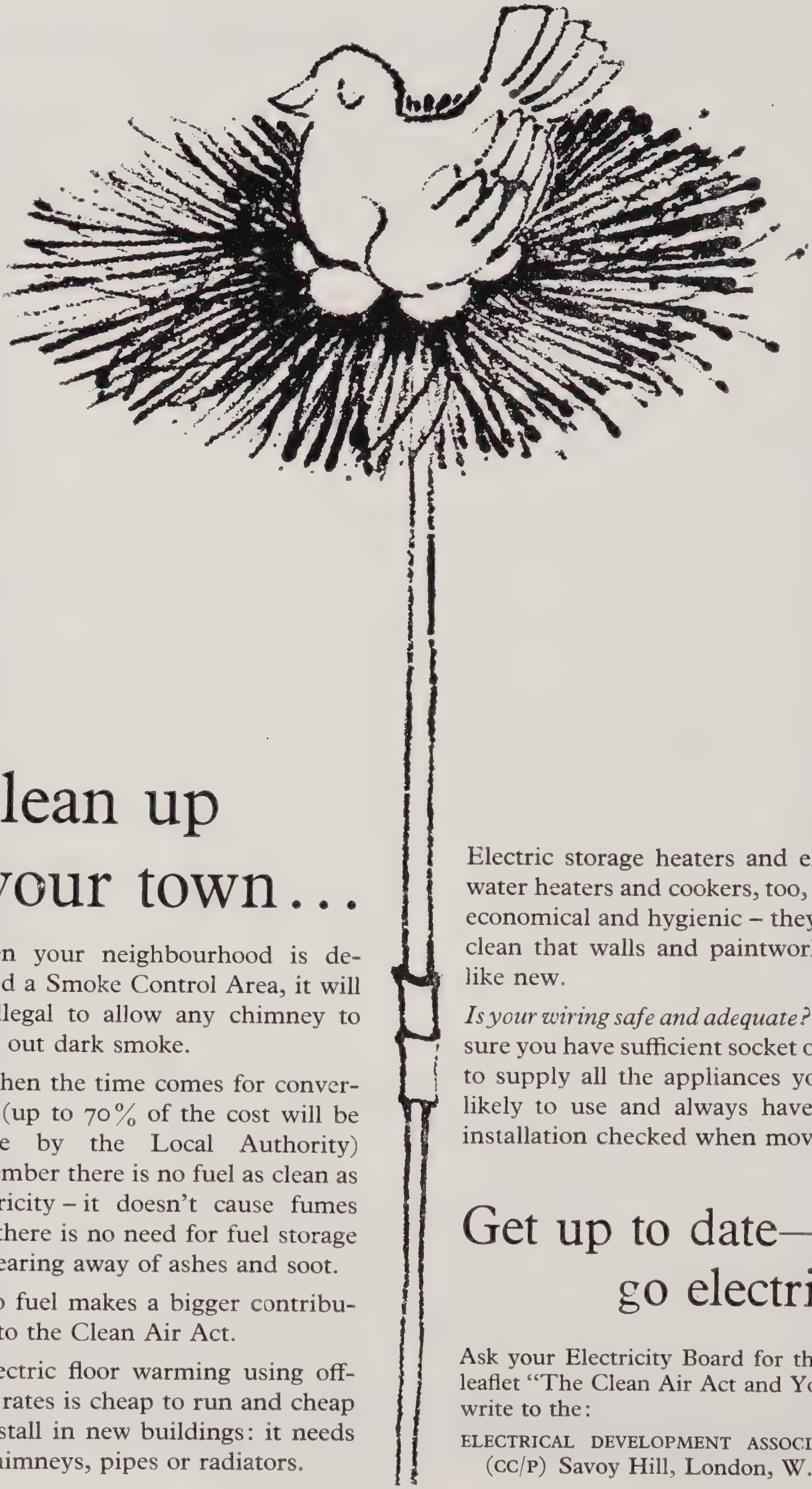
The full range of Incinerators manufactured by this Company, most of which will be on display, are as follows:—

B.100 *Smokeless Incinerator*—For the destruction of putrescent and wet waste without smoke. Simple to operate and in some cases female labour is used. Smoke eliminated and rubbish burnt by fully protected gas burner. Packaged construction. Easy installation. No special foundations required. Not suitable for dry materials. *Typical applications:* Animals, Wet combustibles, Vegetables, Restaurant and Hotel Waste, Markets, Laboratories.

B.200/300 *Smokeless Incinerators*—For the destruction of dry combustible materials. Simple to operate by any class of male labour. Smoke eliminated by either gas or oil burners. Packaged construction. Easy installation. No special foundations required. Not suitable for wet materials. *Typical applications:* General refuse, Plastic, Wood, Paper, Confidential papers, Trimmings, Factory refuse, Office refuse.

B.310 *Smokeless Incinerator*—Embodying all the features of the above Incinerators is therefore equally suitable for destroying putrescent, wet and/or dry materials on the same Incinerator. Is simple to operate with any class of male labour. Smoke eliminated and rubbish burnt by gas burners. Packaged construction. Easy installation. No special foundations required. Suitable for all classes of material. *Typical applications:* Hospitals, Animal disposal centres, Hotels, Chicken Hatcheries and similar.

5 *cu. ft. Incinerator*—This, the latest to join the range of Incinerators put forward by the Company, is applied to the smaller factory, hospital, supermarket, etc. It is modestly priced at £295 0s. 0d. and will adequately deal smokelessly with the materials arising in industrial premises and public institutions.



Clean up your town...

When your neighbourhood is declared a Smoke Control Area, it will be illegal to allow any chimney to send out dark smoke.

When the time comes for conversion (up to 70% of the cost will be borne by the Local Authority) remember there is no fuel as clean as electricity – it doesn't cause fumes and there is no need for fuel storage or clearing away of ashes and soot.

No fuel makes a bigger contribution to the Clean Air Act.

Electric floor warming using off-peak rates is cheap to run and cheap to install in new buildings: it needs no chimneys, pipes or radiators.

Electric storage heaters and electric water heaters and cookers, too, are all economical and hygienic – they're so clean that walls and paintwork stay like new.

Is your wiring safe and adequate? Make sure you have sufficient socket outlets to supply all the appliances you are likely to use and always have your installation checked when moving.

Get up to date— go electric

Ask your Electricity Board for the free leaflet "The Clean Air Act and You" or write to the:

ELECTRICAL DEVELOPMENT ASSOCIATION
(CC/P) Savoy Hill, London, W.C.2.

Stand No.

B11 and C9 **BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION, 2 Savoy Hill, London, W.C.2. Tel: Temple Bar 9434.**

The E.D.A. exhibit introduces some of the many ways in which the Clean Air Movement and the community at large can benefit from the replacement of other fuels by electricity.

ELECTRIC COOKING. Electricity is now established as one of the most popular " fuels " for cooking—this is because it is cheap and clean. The selection displayed here includes apparatus for schools and hospitals as well as a number of domestic models; some models shown are designed specially for municipal housing schemes.

ELECTRIC WATER HEATING. It is now possible to have cheaper " off-peak " electricity for water heating in many dwellings. Installation of the special " off-peak " electric water heater is simple and inexpensive and it is ideally suited to use in municipal housing schemes.

ELECTRIC SPACE HEATING. Electric floor warming is fast becoming the accepted method of heating new houses and flats. Local authorities in all parts of the country are finding this system, which uses electricity at night when charges are lower, ideally suited to properties where low installation and running costs matter most. For the modernization of existing domestic, commercial or public buildings, the latest Unit-plan heaters are available. These operate on the same low rates for electricity taken at " off-peak " periods.

ELECTRIC REFRIGERATION. Many local authorities are now making available to tenants some form of refrigerator and, on health grounds alone, this can be justified. On show is one of several built-in models available for housing schemes.

GARBAGE DISPOSAL. In all-electric housing schemes, the quick disposal of waste vegetable matter is important and an electric under-sink unit to deal with this problem is on show.

ELECTRIC FIRE LIGHTERS. A selection of electric fire lighters, specially developed for use with solid smokeless fuels, is on display.

Many of these applications are eligible for government grant under the Clean Air Act.

A friendly staff will welcome you to the exhibit and is ready to answer your questions on electricity supply or utilization. A wide range of E.D.A. literature is available on request.

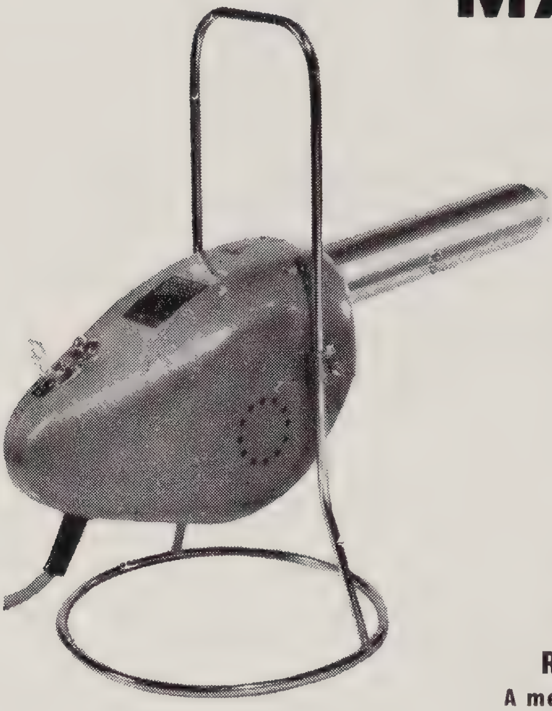
D8 **BRITISH COKING INDUSTRY ASSOCIATION, 74 Grosvenor Street, London, W.1. (Telephone: MAYfair 9736).**

The British Coking Industry Association stand illustrates the uses of " Sunbrite " hard coke as both a domestic and an industrial fuel. Hard coke is an authorized smokeless fuel under the Clean Air Act and ample supplies are available. Although produced

Heard about the NEW

MATCHLESS

Electric Firelighter?



BEST PRODUCTS LTD forecast this is a *must* for every home.

Check the write-up claims in this catalogue for

stand D 18

and then see it for yourself.

BEST PRODUCTS LTD
Ranelagh House, Felixstowe, Suffolk
A member of the A.C. Cossor Group of Companies

Cannon QUALITY

a classic example

OF DESIGNING TO A HIGH STANDARD AND PRODUCING TO A PRICE THE HOUSEWIFE CAN AFFORD

"GasMiser"

Elegant

* Over 250,000 GasMisers in daily use all over Britain

STAND D4

mainly in the Midlands and North, it is distributed throughout the country though fuel merchants. In domestic applications, it is a fuel particularly suitable for closed appliances—stoves, domestic hot water and central heating boilers and solid fuel cookers. On the stand, the advantages of the modern appliances in these fields are shown—including a typical layout for domestic central heating.

The British Coking Industry Association believes that the more households can be persuaded to introduce modern heating equipment of this type, the easier it will be to progress with Smoke Control Areas, for which the supply of specially reactive open-fire fuels is limited.

In addition, large modern automatic coke boilers (up to 10m. B.T.U.s. per hour), and adaptations of sectional boilers for automatic operation, are available, providing simple, efficient, and smokeless heating of larger buildings.

D4 CANNON (G.A.) LTD., Deepfields, Bilston, Staffordshire (Bilston 41241-5)

CANNON are displaying the new range of GasMiser fires.

These new GasMisers retain all the original outstanding features that made possible continuous room heating by gas at a price cheaper than coal burnt in an open fire—over 250,000 homes have already discovered the comfort and proved economy of GasMiser.

Now with a new pleasantly modern styling and choice of four gleaming vitreous enamel lustre finishes, GasMiser is the most attractive fire you can buy.

GasMiser's brilliant radiant panel not only forms a cheerful focal point—particularly for those who are just replacing an open solid fuel fire—but also ensures the rapid warming up of the average sized room even in the coldest weather.

The tremendous heat output from this large radiant panel plus an adequate balance of convected heat from the " Multy jet " convector, provides the most efficient possible way of heating a room for maximum bodily comfort.

It was the outstanding development of the "Multyjet" Hot Air Convector incorporated in the design of the GasMiser that made it possible to use gas for Continuous Room Heating at a price comparable with coal burnt in an open grate.

The GasMiser has been designed to give a tremendous heat output—it will quickly cope with the coldest conditions—that "First Hour" in the evening for those at work all day. Full on, it gives far too much heat for Continuous Heating of an average size room.

A simple dial fitted to the side of the GasMiser gives you a choice of 8 temperatures maintained automatically by GasMinder—

Go smokeless with

CARRON

Efficient, beautifully designed appliances burning solid smokeless fuels are the ideal way to a cosy modern home. Choose from Carron's wonderful selection in attractive colours—the New Vesper Housewarmer, Star Suite, Carol Suite, Carfax Fire, Cardinal Fire, Carmen Drop Front Fire, No. 1 Convector and Calesto Fire.

CARRON

22-26 REDCROSS STREET, LIVERPOOL 1.
TELEPHONE: CENTRAL 1945/6.

33 BATH LANE, NEWCASTLE UPON TYNE.
TELEPHONE: NEWCASTLE UPON TYNE 26940.

LONDON: 15 UPPER THAMES STREET, E.C.4.
TELEPHONE: CENTRAL 7581.

CARRON COMPANY · CARRON · FALKIRK · SCOTLAND
TELEPHONE: FALKIRK 35, 36, 37 and 50.

a thermostat fitted in the bottom of the fire where it is affected by air at room temperature, drawn in at floor level.

The GasMinder increases and reduces the gas consumption to maintain the comfortable temperature you select and prevents you wasting gas—and money.

A9 **CARRON CO., CARRON, FALKIRK, SCOTLAND. (Telephone: Falkirk 35.)**

This world famous firm of ironfounders and engineers whose works are at Falkirk, Scotland, display their revolutionary "Calesto" solid fuel firegrate. This very successful firegrate with its cheerful open fire and unique restricted throat greatly improves room comfort conditions. The "Calesto" fitted with heavy duty boiler is suitable for heating a room of normal construction up to a maximum of 1,750 cu. ft. In addition to supplying normal domestic hot water through a 25/30 gallon indirect cylinder, it is ideal for use with forced circulation small pipe central heating system.

Other solid fuel products displayed include the "New Vesper" Housewarmer, available in two sizes. The large No. 2 size provides space heating by radiation and convection for rooms up to 3,600 cu. ft. and can be supplied with or without boiler. The boiler is capable of servicing a domestic hot water cylinder up to 30 gallons capacity. The "Carol" and "Star" suites, two firegrates of superb elegance, are also shown. These products will burn very effectively all the fuels authorized under the Clean Air Act for smoke control areas. Three other attractive fires are displayed—the No. 2 Convector, the "Carfax" and the "Carmen" Drop Front Fire.

A selection of electric fires and heaters for floor standing complete the Carron display and are shown together with the "Capella" Suite. This wall mounted fire is framed and set in a mesh of Sovereign Gold. With the fire on or off a diffused light gives a warm background glow.

B13 and C11 **CENTRAL ELECTRICITY GENERATING BOARD, Winsley Street, London, W.1. (Museum 4040).**

The Generating Board's exhibit at this year's Clean Air Exhibition describes the comprehensive measures adopted to reduce to a minimum the emissions from power station chimneys.

Grit arresters and electrostatic precipitators now being installed in the large modern coal-fired power stations, at a cost of some £2,000,000 for each, have an efficiency of 99·3 per cent.—about as near to perfection as it is possible to achieve. A further "clean air" measure is the emission of flue gases entirely free from smoke. Electricity is a smokeless fuel and its growing use makes a valuable contribution to the fight against atmospheric pollution.

Stand No.

D1 COALITE & CHEMICAL PRODUCTS LTD., P.O. Box No. 21, Chesterfield, Derbyshire. (Telephone Bolsover 2281).

Live "Coalite" fires in open fire and cooker can be seen on the Stand. Large "Coalite" is the ideal smokeless fuel for every type of domestic grate, old or new, and openable or closeable stoves and hot water boilers.

"Coalite", which is very reactive, will laze or blaze according to requirements. It may be allowed to laze throughout the night or on other occasions when not required, but will draw up to a cheerful blaze immediately the air regulator is opened.

"Coalite" is readily ignited in the ordinary way with paper and sticks, fire lighter or gas poker and burns cheerfully with flame giving radiant heat, maximum comfort and economy.

"Coalite" is equally suitable as best house coal for the open fire and can be obtained from all leading coal merchants.

Prices vary throughout the country according to the geographical position in relation to the Works and carriage charges that are involved. It is sometimes said that "Coalite" is expensive and whilst it may be true when this is considered initially in terms of shillings per hundredweight, the important point is that one buys by weight and consumes by volume. As "Coalite", all of which burns away without risk of flying pieces, is of greater volume than coal, it is cheapest in the long run.

It is most important to note that "Coalite", which is an approved smokeless coal, will burn satisfactorily in any type of grate or appliance without the expense of alteration.

A16 COLLECTRON LTD., 32 Aylmer Road, Leytonstone, London, E.11. (Leyton 3085).

Collectron Limited are showing on their stand a 12 in. 500 c.f.m. dust collecting unit complete with a re-cycling fan and a main fan. Also will be demonstrated an entirely new automatic discharge valve. Visitors interested in the problems of dust collecting in industry will be particularly welcome. The stand will be staffed entirely by technical personnel.

B1 COMBUSTION EQUIPMENT LTD., 61 Belsize Lane, London, N.W.3. (Telephone: SWIss Cottage 4462-3).

Exhibited for the first time in Great Britain is the " Lambion Furnace ", although there are existing installations, one of which has given extremely satisfactory service ever since 1935. The Lambion Furnace is distinguished by the fact that wood and other waste materials can easily be burnt in it without smoke of any kind.

Other exhibits include the " Cory " Grit Arrester, the G.A.P. Fuel Conserver and the Mark IV Furnace Baffle.

Six good reasons for choosing a

CORY GRIT ARRESTER

1. LOW cost.
2. HIGH efficiency, complying with the requirements of The Clean Air Act.
3. LOW pressure drop. NO FANS REQUIRED.
4. RAPID INSTALLATION – 3 have been fitted at one plant in 24 hours.
5. COMPACT AND EASILY ADAPTABLE to any site conditions. Fitted at top, base of stack, or in the ducting leading to it.
6. EASILY MAINTAINED. All parts easily removable.

Stand No. B1

COMBUSTION EQUIPMENT LTD

61 BELSIZE LANE, LONDON, N.W.3. Swiss Cottage 4462/3

Stand No.

A4 and A8 **COAL UTILISATION COUNCIL, 3 Upper Belgrave Street, London, S.W.1. (Telephone: Belgravia 8141). And at Aberdeen, Birmingham, Bristol, Cambridge, Cardiff, Edinburgh, Glasgow, Leeds, Manchester, Newcastle-upon-Tyne, Nottingham, Plymouth, Reading and Tunbridge Wells.**

The Coal Utilisation Council is a non-commercial organization concerned with promoting the efficient domestic use of all solid fuels. In existing or proposed smoke control areas the Council's policy is aimed at the retention of the domestic market for solid fuel.

The Memorandum on Smoke Control Areas, published by the Ministry of Housing and Local Government in connection with the Clean Air Act, quotes the C.U.C. as one of the organizations from which local authorities, contemplating the establishment of Smoke Control Areas, may obtain advice and assistance.

On display is a complete range of the various types of approved solid fuel appliances and of the authorised smokeless solid fuels, three different types of which are being shown burning daily. There is a demonstration showing how maximum efficiency can be obtained from an open fire by using it also to supply hot water and partial central heating.

The exhibit explains the ways in which the Council can be of service to local authorities that are setting up Smoke Control Areas, under the following headings:

Publications

The various publications issued by the Council which are available to local authorities are displayed.

Training Courses

The Ministry of Housing and Local Government Memorandum on Smoke Control Areas says that Local Authorities should ensure that new solid fuel appliances have been correctly installed in accordance with the methods recommended by the Coal Utilisation Council.

Exhibitions and Publicity

The stand illustrates the various ways in which the local Joint Service Committees of the Council are helping local authorities in proposed Smoke Control Areas by means of exhibitions of various types, adapted to suit local conditions, advertising and leaflet distribution.

Technical Services

The Technical services of the Council are available to any local authority in connection with the domestic use of solid fuel in Smoke Control Areas.

Stand No.

B12 DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, State House, High Holborn, London, W.C.1. Telephone: Chancery 1262.

WARREN SPRING LABORATORY, Gunnels Wood Road, Stevenage, Herts., Telephone: Stevenage 2080.

Although it is possible for large consumers of fuel, such as modern power stations, to operate without smoke and grit, no really effective method has been found to reduce the emission of SO_2.

Objections have always been made to methods which involve washing the flue gas, on the grounds that the washed gas is cool and moist, and, lacking buoyancy, can, under certain conditions, descend rapidly to ground level, creating a local nuisance. This difficulty could be overcome if a suitable dry process existed.

On the stand is a model of a pilot plant erected at Warren Spring Laboratory to investigate the claims made for a dry process developed in Germany. This uses a solid adsorbent which can be reactivated by heating with an inert gas; the SO_2 and SO_3 adsorbed are then given off as SO_2, in a sufficiently concentrated form for recovery and sale.

Laboratory-scale tests have shown promising indications but no results are yet available from the pilot plant. It is clear, however, that the process is unlikely to be cheap and its industrial use would therefore only be envisaged where serious sulphur dioxide pollution exists.

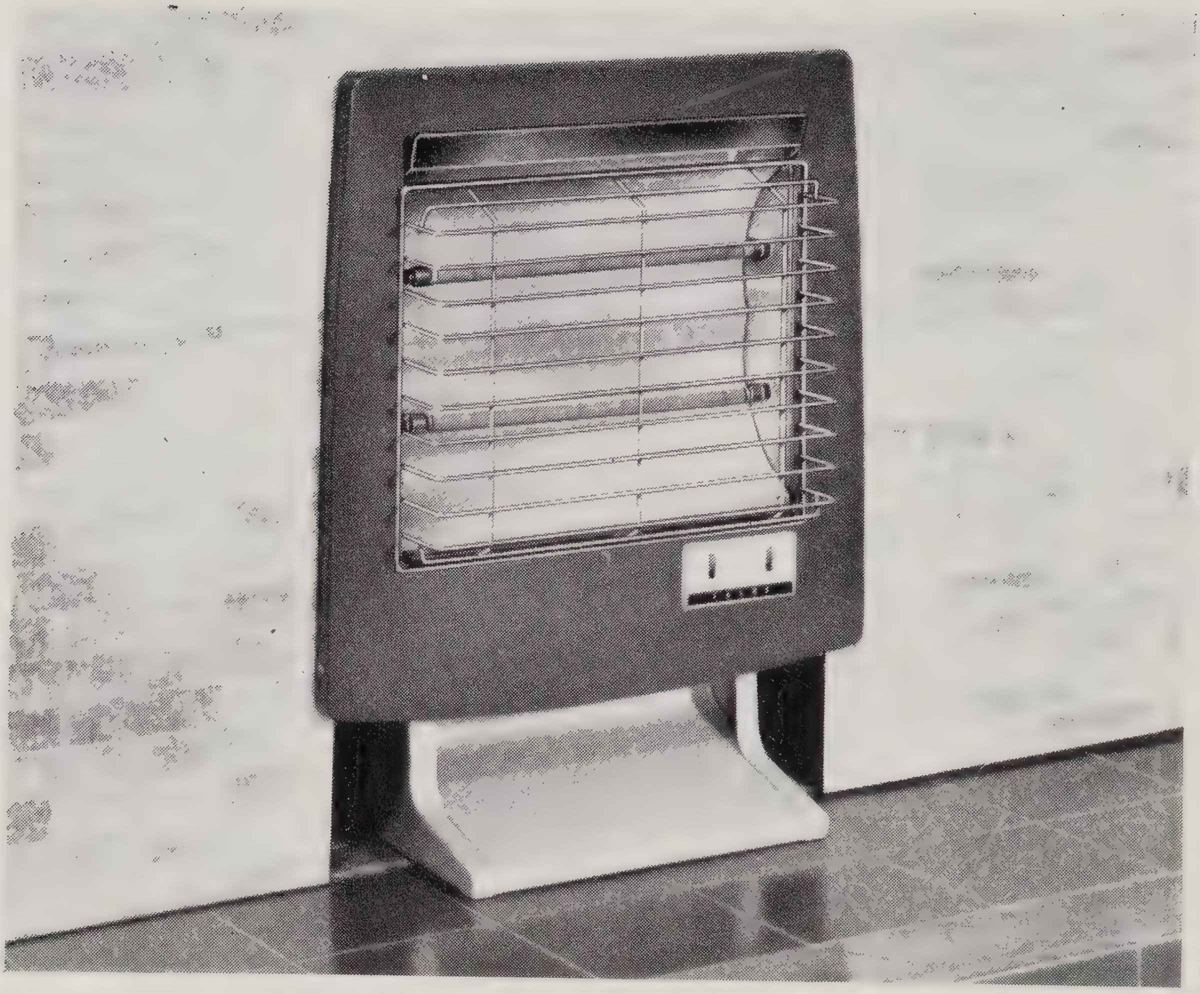
A11 DISTRICT BANK LTD., Head Office: 13 Spring Gardens, Manchester, 2. (Telephone: DEAnsgate 4300).

Exhibitors, delegates and visitors are cordially invited to make use of the banking facilities provided on our stand in the Exhibition Hall. We also have a branch office in Harrogate which is at your service.

D11 FALK, STADELMANN & CO. LTD., 91 Farringdon Road, London, E.C.1. (Holborn 7654).

Falk's new "Cleanair" range of Domestic Heating Appliances displayed at the Exhibition reflects the Company's appreciation of the importance attached to the widespread introduction of Clean Air Zones under the Clean Air Act 1956 and its conviction that as electricity is manifestly the cleanest and most convenient fuel, most householders will purchase electric heaters of one type or another.

During the design stage of these new appliances care was taken to ensure ease of installation, high efficiency and a high standard of quality throughout. All these appliances are approved by the British Electrical Approvals Board.



COMMODORE

FOR ATTRACTIVE 'CLEANAIR' HEATING

FALKS CLEANAIR RANGE COMPRISES:
CARDINAL
(infra-red outset)
CAVALIER
(outset radiant)
COMMODORE
(inset radiant)
CONCORD
(inset radiant)
CADET
(inset radiant)

This extremely attractive and versatile heater with illuminated plinth was designed in collaboration with John Barnes, F.S.I.A. The appliance can be fitted into most 16″ x 22″ fireplace openings to close off the aperture. Two ratings are available: 2 kW or 3 kW. Voltage is 200/220, 230/250 AC only. The U. 95775 has a special fixing bar, which is supplied as an extra, to enable the heater to conform with the fixing requirement of the local authority and is eligible for grant under the Clean Air Act. Colours: Corinthian Red and Grey/Spanish Gold and Grey. Dimensions: height 23″, width 18″, depth 7½″. **U.95775/2** 2 kW Total Price **£8.8.10** (inc. P.T.) **U.95775/3** 3 kW Total Price **£9.6.11** (inc. P.T.)

FOR FURTHER DETAILS OF FALKS CLEANAIR RANGE OF HEATERS POST THIS COUPON OFF TODAY TO: DOMESTIC ELECTRICAL APPLIANCE DIVISION 91 Farringdon Road, London, E.C.1. Branches: Birmingham, Brighton, Cardiff, Edinburgh, Glasgow, Leeds, Liverpool, Manchester, Newcastle, Southampton

FALKS FALKS

Please send me, free of charge, a copy of Brochure No. P.2824 which contains further information on FALKS CLEANAIR RANGE.

NAME ....

ADDRESS ....

....

In selecting the colour schemes the advice of experts in this field was sought to create schemes which would enhance any home or office.

Commodore Heater

Available as a 2 kW or 3 kW appliance which will fit into most 16 in. × 22 in. fireplace openings and is fixed by means of a concealed fixing bar. The plinth is illuminated. Alternatively available as a wall mounted inset heater but without illumination. This model is available only in 2 kW rating. Prices range from £7 16s. 9d. for the inset model to £9 6s. 11d. for the 3 kW outset model. These prices include Purchase Tax.

Cavalier Outset Heater

An entirely original design so shaped to project the warm air as far from the wall surface as possible thus reducing wall discolouration to the minimum. Price £6 10s. 2d. including Purchase Tax.

Concord 2 kW Inset Heater

This heater uses the reflector and element assembly of the Cavalier and is recessed into a panel. Price £6 17s. 7d. including Purchase Tax.

Cadet Inset Heater

Available in 1 kW or 2 kW models and represents outstanding value. Price, 1 kW £3 12s. 6d. including Purchase Tax. 2 kW £4 14s. 2d. including Purchase Tax.

Cardinal Infra Red $2\frac{1}{4}$ kW Outset Heater

This elegant appliance contains three 750W Silica tube elements in individual reflectors. Price £14 18s. 1d. including Purchase Tax.

D17 **FUEL EFFICIENCY (ARROW PRESS LTD.), 65-66 Turnmill Street, London, E.C.1. (Telephone: Clerkenwell 8201-8).**

Fuel Efficiency is a monthly publication whose chief concern is to promote the use of the most appropriate fuel and equipment for each heating purpose. It is interested in every aspect of fuel usage, including that of smokeless burning, and in the efficient use of all fuels. Its readers include plant engineers, consultants, housing managers, borough engineers and surveyors, building contractors, architects, etc. Subjects covered include process and space heating in industrial and commercial undertakings, nationalized industries and scientific and technical institutions. The most up-to-date methods of heating for new housing schemes and for office blocks are continually under review.

Subscription: 42s. per annum, including a copy of the annual Register of Industrial Heating.

Stand No.

B10, C8 and A3 **THE GAS COUNCIL, 1, Grosvenor Place, London, S.W.1. (Belgravia 4321).**

The Gas Council's two stands (GAS No. B10, C8 and COKE No. A3) are centres of up-to-date information on how the use of Gas and Coke in home and factory is contributing to the ideal of a smoke-free Britain.

Inasfar as the domestic chimney is responsible for emptying nearly half of the smoke over this country, the use of gas in the home is of particular value in fulfilling the requirements of the Clean Air Act. At the same time, it materially benefits family health and well-being and cuts cleaning bills for clothes, curtains, furnishings, windows and paintwork. Installation of modern gas-burning appliances is also easily accomplished. A gas cooker, sink heater, refrigerator, clothes washer or boiler, will fit compactly into the kitchen, while a gas radiant convector room heater will give instant warmth in a living room or bedroom and eliminates all the dirt and drudgery arising from smoke pollution. Of special interest in the domestic field, are the new developments in central heating displayed on the stand which satisfy both the need for clean air and greater comfort. They include "small bore" central heating, which can be installed in existing houses with a minimum of structural alteration, unobtrusive pipe runs, and for a reasonable capital outlay; and gas warmed air heating systems to give either economical "selective" heating or full comfort in all rooms, passages and halls throughout a house or flat. In addition, a gas circulator, heating and water tank or cylinder, can be fitted to an air heating unit to provide constant hot water all the year round. Only gas can give this combined smoke-free heating and hot water service all round the clock and at such a relatively low cost.

The Gas Industry's Solid Smokeless Fuel makes an excellent alternative for winter space heating and water heating: a coke-fired boiler will give a combined central heating and hot water service in the most economical way possible; or coke will give all-day warmth and comfort with similar economy when it is burned either in an open fire or in a heating stove. Both types of fire can be fitted with back boilers to give a full hot water supply at little extra cost in fuel consumption. Many open fires are supplied with a deepening plate which acts as a safety device when the room is unoccupied, and ensures that the fire can be banked up and will stay alight for a long period (or overnight). Open fires are also available with built-in gas burners which ignite the fire quickly.

Gas and coke, in brief, used either separately or in combination, provide the family with new comfort standards and meet perfectly all the requirements of the Clean Air Act for the domestic use of smokeless fuel.

Delegates are invited to visit the Gas Council's two stands, where expert advice on gas and coke and its contribution to Clean Air can be obtained.

Stand No.

C3 JAMES GORDON & CO. LTD., Abbey Road, Park Royal, London, N.W.10. (Elgar 2111).

James Gordon & Co. Ltd. will have on show examples of complete instrumentation for boilers of all types and sizes and for power plant, including pressure and vacuum recorders and indicators, liquid level recorders and indicators, temperature measuring instruments, flowmeters, B.Th.U.Meters, humidity meters, level indicators and recorders, telemetering systems, etc.

Other exhibits will include Mono chemical type and Elliott thermal conductivity type gas analysis instruments for CO_2, O_2 and other gases; Igema distance boiler water level indicators and alarms; Konitest dust meter for measuring, indicating and recording dust burden in industrial gases and atmospheres; automatic combustion control, pneumatic, electronic or electrical for boilers, power plant and furnaces; temperature control for superheated steam temperatures, chemical process temperatures, etc., steam desuperheaters and reducing valves.

B2 HARGREAVES (WEST RIDING) LTD., Bowcliffe Hall, Bramham, Boston Spa, Yorkshire. (Telephone: Boston Spa 2081).

The HARGREAVES Group of Companies are distributors of solid fuels over a wide area of the country and in association with Charrington, Gardner, Lockett Ltd., as Charrington-Hargreaves Ltd., are distributors of Mobil fuel oils for the North of England.

Fuels are distributed by road, rail and canal; the Group also has Shipping interests.

To maintain services to consumers the Group has developed a comprehensive Technical service, to advise on all fuel and heating problems, industrial and domestic. The advice given on fuel selection is always impartial, and in the interest of the customer. To further this service we have at our head office a modern fully equipped laboratory, capable of undertaking all types of fuel analysis.

The Technical services are staffed by a qualified team of Chemists and Engineers and are always available to help solve your fuel problems.

Since the passing of the Clean Air Act, increased attention has been paid to the problem of smoke abatement, and many Local Authorities have taken positive steps in this matter by the formation of " Smoke Control Areas ". The Hargreaves Technical services are able to supply the specialist technical knowledge to implement the Clean Air Act, and to date have been instrumental in improving boiler plant by either plant conversion or a change of fuel.

At the Clean Air Exhibition, many types of fuels are on

HARGREAVES

FUEL DISTRIBUTORS

offer

A COMPREHENSIVE TECHNICAL
ADVISORY SERVICE

Visit our stand No. B 2

Advice given on Smoke Control, Boiler plant,
Domestic and Industrial Heating,
Fuel handling and storage, etc.

HARGREAVES (WEST RIDING) LTD.
BOWCLIFFE HALL - BRAMHAM - BOSTON SPA
YORKSHIRE

TELEPHONE BOSTON SPA 2081

display, which are distributed by the Hargreaves Group, together with illustrations of the Group's activities in support of Clean Air through help and advice to fuel users. The Group's stand at this Exhibition will be staffed daily by Technical and Sales personnel, who will be available to advise on all aspects of fuel problems.

B15, B16, B17 and C13 **HEAD WRIGHTSON IRON & STEEL WORKS ENGINEERING LTD., Teesdale Iron Works, Thornaby-on-Tees, Yorkshire. (Telephone: Thornaby-on-Tees 62241).**

Head Wrightson Iron & Steel Works Engineering Ltd., are showing details of the equipment they can offer as a complete gas cleaning service to industry. This will include:—

Flooded Disc Scrubber.

This is a high efficiency scrubber capable of collecting submicron particles from process gases. It will give weight efficiencies in excess of 99 per cent. and is an ideal unit for the collection of electric furnace, open hearth, oxygen-blown converter and cupola fumes as well as dusts and fumes from all processes in the cement, lime, foundry and chemical industries.

A unique feature of this scrubber is its ability to operate at constant efficiency over a wide range of flow rates. This is achieved by automatically adjusting the position of the scrubbing disc within the tapered scrubber casing so as to maintain constant pressure drop and efficiency.

Cyclo-trell.

The Cyclo-trell is a multi-tubular centrifugal collector ideally suited for the high efficiency collection of process dust. It is relatively cheap and compact, has a low power consumption and requires little maintenance. It is frequently used as a pre-cleaning to reduce the load on a secondary collector.

Fabric Filters.

These filters can be offered for the collection of all dry dusts and fumes at efficiencies exceeding 99·5 per cent. A complete range of natural organic-synthetic and fibre glass fabrics is available for use in the units and gases at temperatures of up to 500°F can be handled by them.

Electrostatic Precipitators.

Head Wrightson-Research Cottrell precipitators offer all these advantages.

Low maintenance—no expert attendance or expensive replacement parts.

Low draught loss—the pressure drop between inlet and outlet is extremely low—averaging only a few tenths of an inch of water.

Low power cost—at the high voltage necessary to maintain

HOWDEN

SPECIALISTS IN THE DESIGN AND MANUFACTURE OF EQUIPMENT FOR MOVING OR COMPRESSING AIR & GASES, TRANSFERRING HEAT FROM ONE FLUID TO ANOTHER, CLEANING AIR & GASES

TRADE MARK

JAMES HOWDEN & COMPANY LIMITED
REGISTERED OFFICE & FACTORY
195 SCOTLAND STREET, GLASGOW, C.5
LONDON OFFICE
15 GROSVENOR PLACE, S.W.1

Stand No.

the electrical field, the current and power requirements are extremely low.

Durability—installations made more than twenty-five years ago are still operating without appreciable change or loss of efficiency.

Any temperature—up to 1,200°F, or even higher, depending on the application and materials used in construction.

Any capacity—from a few hundred c.f.m. to several million c.f.m.

B7, B8, B9, C6 and C7 **JAMES HOWDEN & CO. LTD., 195 Scotland Street, Glasgow, C.5. (South 2131).**

James Howden and Co. Ltd., established in 1854, have manufactured and installed equipment for power stations and industrial plant throughout the world. The Company specializes in draught plant and dust collecting equipment and is constantly developing new techniques to meet the increasing demands of the present day. The wide range of knowledge and experience accumulated over the years in these fields enables Howden to submit proposals for dealing with all problems concerning the handling and conditioning of air and gases.

D19 **CHARLES KNIGHT & CO. LTD., 11-12, Bury Street, St. Mary Axe, London, E.C.3. (Mansion House 5477).**

In addition to a selection of their books and forms, Charles Knight & Co. Ltd. are distributing from their stand copies of their publication *The Local Government Chronicle.* The *L.G.C.* has a traditional interest in public health. Recently, its articles on health topics have received wide publicity in the National Press—one example being the article on 31st March on an urgent public health and highways problem. Public Health Departments find much to interest them in the regular features as well as the special articles and rely particularly on the advice given in the Legal Queries Section.

C2 **LAWDEN MANUFACTURING CO. LTD., St. Peter's Place, Broad Street, Birmingham, 1. (Telephone: Midland 7845-7).**

Lawden Manufacturing Co. Ltd., specialize in the design, manufacture and installation of the following equipment:

Complete refuse disposal plant producing as a saleable product, pulverized vegetable matter for use as fertilizer.

Dust and fume control equipment, air conditioning, heating and ventilation systems, installations including ductwork and fans in sheet metal, plate, plastic or fibreglass; welded, rivetted, lock-formed or bonded according to specific requirements. Incorporated in the designs are cyclones, high efficiency centrifugals, wet collectors and fabric arrestors.

DESIGNERS AND MANUFACTURERS OF

DUST & FUME EXTRACTION PLANT

REFUSE DISPOSAL PLANT

VENTILATION SYSTEMS

SPRAY BOOTHS

TANKS, PRESSURE VESSELS,
ETC.

Lawden Manufacturing Co. Ltd.
St. Peter's Place, Broad Street,
Birmingham, 1

Phone MIDland 7845 (3 lines)

" Send your drawings or particulars and leave the rest to us "

The foundry engineering department are equipped to carry out the design and execution of foundry mechanization schemes, and a wide variety of foundry equipment is available.

In addition, facilities are available for carrying out fabrications of which tanks, plain mild steel, lead and plastic lined, furnace casing, belt conveyors, rotary mould conveyors, precipitator plates and screening form part of the company's regular products in this field.

Lawden Manufacturing Co. Ltd., specialize in the one off items where a high degree of skill is the main essential.

D13 LION STAMPING COMPANY LIMITED, 35 Marshgate Lane, Stratford, E.15. (Telephone: MARyland 5161).

In the field of domestic space heating nothing has been so spectacular as the increasing popularity of the radiant oil heater, and today over 4 million appliances of this type are used in homes throughout the country. Provided the purchaser has chosen wisely, they can expect to secure warmth at a fraction of the cost of other forms of heating, combined with a higher standard of comfort and convenience.

With the averaged sized room, this heater costs 1s. 3d. per day to run and makes this by far the most economical form of heating, combined with the highest standard of comfort and convenience.

In no small measure is the rapid development of this type of heater due to the Lion Stamping Company Limited whose specialized experience in both the domestic and industrial fields covers a period of nearly a quarter of a century. It was in 1946 that this company pioneered the first gravity-feed heater on the market and today millions of heaters bearing the familiar " Leo " trade-mark are in use throughout the world. Never content with the proven high efficiency of its free-standing models, the company's technicians have since 1956 devoted their energies to perfect a design to meet the requirements of most households—*a model that could be fixed safe* and *secure* in the *fireplace*. After much laboratory research and building special testing units to provide the most exacting chimney conditions, the Leo-Fi flued space heater was developed.

Clean Air Act: The Leo-Fi fully complies with the provisions of the Act and is eligible for the 7/10th grant applicable to householders complying with a Smoke Control Order. You are cordially invited to inspect this unique model on our stand and obtain copies of the illustrated descriptive brochure containing full specification.

The ECONOMY heater for SMOKELESS ZONES

Will heat a room for approximately 1s. 3d. a day—a THIRD the cost of coal, gas or electricity

LEO-FI

The ONLY
Oil Heater of this design!
Fits SECURE in the FIREPLACE

> TESTED by Government scientists and APPROVED by the Ministry of Housing & Local Government for the $\frac{7}{10}$ths GRANT in Smokeless Zones

£17 . 9 . 6

4 UNIQUE PATENTS

1. Thermostatic—vent exhaust fumes UP chimney—anti down draught shutter
2. New Burner
3. Air-cooled Fuel Tank
4. Variable Heat Control Valve

Praised by thousands of delighted users. A typical tribute—Mr. K. C., of London, writes: *"It is really efficient—and as well as the convenience, is the ease of operation—it does just what you claim—effectively heats the room. The convection power is quite unbelievable—it gives and maintains a wonderful warmth in minutes—and is so economical too! Fitting so safely into an existing fireplace makes the Leo-Fi a joy to look at!"*

Send today for Brochure with FULL Specifications

To Lion Stamping Co. Ltd
Marshgate Lane, London, E.15

Stand No.

A12 and A13 **LODGE-COTTRELL LTD, George Street Parade, Birmingham 3. (Telephone: Gatley 3600).**

For fifty years, Lodge-Cottrell Limited have specialized in the electrical precipitation system of gas cleaning and dust collection, and their stand naturally includes particulars of this type of equipment.

This year, however, Lodge-Cottrell present as their main feature a new approach to the fabric filter. Designed to suit the needs of today's industrial processes, the Lodge-Cottrell Pocket Filter is compact, efficient and economical. Instead of the conventional sleeves or bags, banks of pocketed-panels are used allowing a much greater filter cloth area to be contained in a given space. Cleaning of the fabric is by a separate scavenge air-flow, automatically operated in sequence throughout small sections of the plant. There are no moving parts whatsoever in the dirty gas stream, nor is any mechanical shaking apparatus involved. An ingenious arrangement of inlet and outlet gas manifolds ensures an even gas distribution through the plant and a constant velocity. These features combine to produce a filter which is competitive both in capital and operational costs.

A typical pocket-panel is exhibited as well as samples of fabric and an animated panel illustrating the electrical precipitation process. Literature available includes a folder describing the new pocket filter, a general brochure entitled *Introduction to Electrical Precipitation* and a wallchart briefly describing electrical precipitation for use in technical colleges and training establishments.

D7 and outside main entrance **MAYWICK APPLIANCES LIMITED, Wickford, Essex. (Telephone: Wickford 3481).**

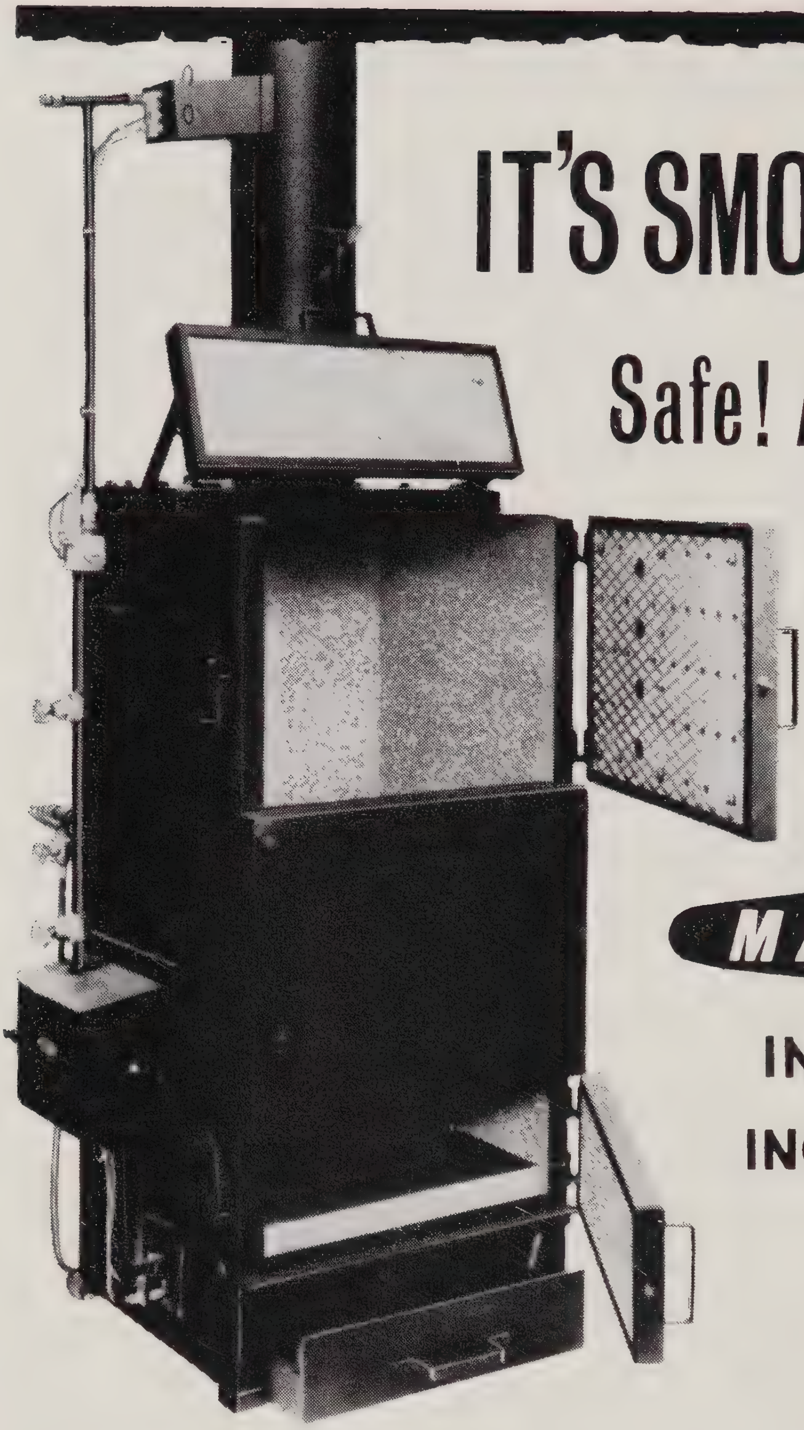
Of particular interest to all those who have pledged themselves to rid Britain of air pollution is the Maywick Industrial Incinerator.

Maywick Appliances realized from the very first stage of designing this unit that what was needed was an incinerator capable of consuming both dry and wet waste quickly and without smoke, yet at an economic price. This is precisely what they have achieved.

This incinerator, which runs off propane gas or town gas, has a capacity of 8 cu. ft., and it is the after-burner and baffle fitted in the flue and the incorporation of an air wheel smoke diluter which ensures that all particles of smoke are consumed before they reach the atmosphere.

A smaller model incinerator with a capacity of 3½ cu. ft., incorporating many of the special features of the Industrial Incinerator, is also on view.

On this stand, too, you can see some of the Maywick-Schwank space heaters. These run off propane or town gas and are being marketed for the first time this season. Orders have already shown a big demand.



IT'S SMOKELESS!

Safe! Automatic!

THE

MAYWICK

INDUSTRIAL INCINERATOR

See it on
stand D7

With the Maywick Industrial Incinerator large quantities of waste products—whether dry or wet—can be disposed of quickly, hygienically and economically, without even a wisp of smoke and absolutely no odour! Fuelled by gas, either from the mains supply or from propane cylinders, this compactly designed unit is extremely clean and simple to operate—a flame failure control device ensuring its complete safety. Two-way opening doors make loading easy and a built-in time clock allows burning operations to be carried out automatically. You can eliminate the need for special refuse collections with the Maywick Industrial Incinerator. See it for yourself on stand D7 or write to us for further details.

MAYWICK APPLIANCES LIMITED WICKFORD ESSEX TEL 3481-5

Radiant heat is produced by these heaters—and of particular interest are the mobile models, which are windproof and so can be used to warm workers engaged on outdoor work, such as building sites and road repairs.

There is one model, the Handi-heater, which is bound, in time, to take the place of the brazier commonly seen at the entrance to night-watchmen's huts all over the country.

B14 and C12 **THE MINISTRY OF HOUSING AND LOCAL GOVERNMENT, Whitehall, London, S.W.1.**

"Clean Air"—a 21-minute film in colour will be shown on the Ministry stand. The film shows how smoke control affects individual householders and gives the sort of information needed by people whose homes may soon be in smoke control areas. The film was made by Random Film Productions for Shell Mex and B.P. Ltd.

It can be borrowed free by local authorities from the Central Film Library, Government Building, Bromyard Avenue, Acton, London, W.3. or from the Central Film Library of Wales, 42 Park Place, Cardiff.

C10 **MORPHY-RICHARDS (CRAY) LIMITED, 50 Conduit Street, London, W.1. (Telephone: Regent 4080).**

Each room in the home presents a different heating problem, so Morphy-Richards have produced a range of heaters for every heating job. This means that whatever the size of room, there is a Morphy-Richards heater to meet requirements.

On stand C10 will be shown the complete range of heaters, convectors and radiant fires, including new additions. Also being featured is the new switch robot, which switches on any heater automatically within any period up to eighteen hours.

The new, modern colours will be exhibited throughout the range, which is designed to give trouble-free *clean* (no soot or ashes) heating, at an economical cost.

D16 **THE MUNICIPAL JOURNAL GROUP OF COMPANIES, 3/4, Clement's Inn, London, W.C.2.**

Displayed on this stand will be *Municipal Engineering*, *The Municipal Journal*, *The Municipal Year Book* and sundry books and publications produced by other companies within the Group for a large and varied number of official bodies.

Municipal Engineering caters specifically for all the technical officers of local government whose work is directed towards improving health and welfare of the community.

REXCO

SMOKELESS COAL

gives far more pure heat!

NATIONAL CARBONISING COMPANY LTD · MANSFIELD · NOTTS.

It is *the* weekly journal most widely read by public health inspectors and public cleansing officers. Its coverage of such matters as the control of air pollution, sanitation, food hygiene, meat inspection and slum clearance has made it essential reading for these officers.

The Municipal Journal each week highlights news and views on all aspects of local government affairs through co-operation with government departments, local authority associations and societies and individual councils. It keeps its readers abreast of current thought and development. Administration, finance, law, building and planning, public health, refuse disposal, sewerage and sewage treatment—these and all other aspects of local government work are continually kept under review.

Recognized as the encyclopaedia of local government and an essential work of reference, *The Municipal Year Book* contains full statistical data of all local authorities. It includes names, addresses and telephone numbers of 40,000 officers of local government and of Associations, Institutions and Societies. In all, some 2,000 pages.

The Group is also responsible for the organizing of exhibitions held in conjunction with the annual conferences of the Association of Public Health Inspectors, the National Housing and Town Planning Council, the Institute of Works and Highway Superintendents, the Chief Fire Officers' Association and the Institution of Fire Engineers and organizes the Public Works and Municipal Services Exhibition held biennially at Olympia, London.

A2 NATIONAL CARBONISING CO. LTD., 14 Woodhouse Road, Mansfield, Nottinghamshire. (Telephone: Mansfield 2357).

The makers of Rexco Smokeless Coal have as the main feature of their stand a typical British fireside scene. It shows a lounge with an open fire blazing merrily in the hearth.

The preservation of this traditional scene in homes throughout the country is being made possible—despite the regulations of the Clean Air Act—by the existence of Rexco " Approved " solid fuels.

This modern form of heating in a traditional setting becomes increasingly popular every year and the National Carbonising Company is constantly stepping up its production.

Rexco is made from the finest quality large coals and when burned produces bright flames and a strong radiant heat without smoke.

It is easily ignited and can be used successfully in any type of grate, old or new, thus avoiding the need to fit special grates and provide gas ignition.

Rexco Smokeless Coal will be burnt in the famous " Redfyre " No. 4A backboiler unit, incorporating a Redfyre " 60 " continuous burning fire which is installed under fire. This backboiler is

For the latest developments in coal heating

Visit the National Coal Board stand

D2

See a wide range of ancillary 'clean air' equipment for use with coal including a flue cleaning unit, grit arrestors, furnace tube baffles, and grit measuring equipment. Here is abundant proof that coal, burned the modern way, can meet every demand set for industry and commerce by Clean Air Legislation.

LEARN ALL ABOUT THE HEAT INVESTMENT PLAN . . .

The cost of your new coal-burning boilerhouse equipment can be spread over five years under the National Coal Board's Heat Investment Plan. Under the confidential, no-deposit, low-interest terms of this comprehensive plan, vital capital can be conserved while you are enjoying the economies that result from really modern coal-burning equipment. Savings in fuel and labour usually speedily repay the outlay.

. . . AND THE TECHNICAL ADVISORY SERVICE

Are you making full use of the National Coal Board's advisory service to commerce and industry? This free service offers you expert advice on operation of existing plant to improve efficiency, on the replacement of equipment, on the choice of the most suitable grade of coal, on the siting of new boilerhouses, on the installation of new boilers and mechanical stokers, on coal and ash handling and on storage—ready information and assistance, in fact, on anything and everything that will lead to the more economical, more efficient use of coal. Get the best results from your coal and equipment by consulting the *National Coal Board's Advisory Service* to commerce and industry, or your usual coal supplier.

***PROGRESSIVE INDUSTRY PLANS ITS FUTURE ON* COAL**

ISSUED BY THE NATIONAL COAL BOARD

designed for heating up to 1,500 cu. ft. and will support radiators with a total heating area, including service pipes, of 70 sq. ft. (or 40 sq. ft. if it is also supplying domestic hot water). A typical example is installed on the stand.

Also on display is the Redfyre magazine boiler. This will be exhibited in an " English Rose " kitchen setting. This boiler has an output of 20,000 B.T.U.s per hour and is capable of heating two/three radiators plus domestic hot water, or will heat as many as five radiators if hot water at the tap is not required.

Of the grades available and on display at the Exhibition, Rexco " Large " is recommended for open type grates and Rexco " Nuts " is best suited for all types of domestic hot water boilers, stoves and cookers.

Staff on the stand will be pleased to give information concerning the whole range of Redfyre solid fuel appliances which are suitable for use on local authority contracts and in Clean Air zones generally.

D2 NATIONAL COAL BOARD, Hobart House, Grosvenor Place, London, S.W.1. (BELgravia 2020)

The National Coal Board Stand shows how solid fuel can meet the problems set for industrial and commercial consumers by clean air legislation. On display is a range of ancillary equipment designed to ensure clean air. These include a flue cleaning unit, grit arrestors, furnace tube baffles and grit measuring equipment. The Board's Technical Service and Heat Investment Plan are also featured on the stand.

B4 NATIONAL INDUSTRIAL FUEL EFFICIENCY SERVICE, 71 Grosvenor Street, London, W.1. (Hyde Park 9706).

N.I.F.E.S. work continues to show that only when optimum efficiency is reached and maintained on combustion equipment can the greatest reduction in air pollution from industrial chimneys be achieved. It is generally agreed that the reasons why boiler plants give rise to smoke are, in order of importance, poor operation, inadequate maintenance and unsuitable equipment.

Many of N.I.F.E.S. Regular Service Agreements were negotiated because there was a smoke problem to be overcome, and have been continued to ensure that the improvement is maintained. Often, there are special difficulties to be solved: for example, overloading of boilers, the burning of waste materials, such as wood, which may involve re-designing the combustion chamber, or the improvement of the draught systems.

Panels on the Stand give case histories of firms who, with N.I.F.E.S. help, have overcome their smoke problems and in so doing have reduced fuel costs. N.I.F.E.S. offices have been provided with apparatus for measuring grit and dust emission so that they can assist industry to comply with the requirements of the Clean Air Act.

Stand No.

The case quoted on the Stand illustrates how important is the correct interpretation of the measurements obtained. Here the grit arrestor itself was efficient. The survey uncovered the real causes of grit emission and led also to a substantial saving of fuel.

Photographs of Courses organised by N.I.F.E.S. underline the importance of correct training at all levels in order to ensure correct operation of plant. Other panels show the part played by N.I.F.E.S. in assisting the brick and pottery industries to reduce fuel consumption and increase production.

B18 NATIONAL SOCIETY FOR CLEAN AIR, Field House, Breams Buildings, London, E.C.4. (Telephone: CHAncery 5038).

Examples of some of the Society's publicity material will be shown not only on this stand but also in various parts of the exhibition. This material includes posters, leaflets, photographs and portable exhibition units which are available on loan to local authority and corporate members for their own exhibitions. A catalogue of this material is available on request.

Copies of the Society's publications—the quarterly journal " Smokeless Air " and the " Clean Air Year Book " will be on sale, together with a wide range of other books and literature.

B19 NATIONAL SOCIETY FOR CLEAN AIR, Conference Office. (Telephone: Harrogate 2293/3007).

All delegates are required to register at the Conference office as soon as possible after arrival. A printed list of delegates will be available there on request and staff will answer delegates' queries and provide information. The cashier's office will also be located here for the receipt of payments.

D14 PERGAMON PRESS LTD., Headington Hall, Oxford. (Telephone: Oxford 64881). Offices in Paris, Frankfürt and New York.

We are international publishers of scientific, technical and educational text and reference books and also major publishers of scientific journals. These include *Air and Water Pollution*, *Productivity Journal* and *Annals of Occupational Hygiene*, copies of which can be seen on the stand.

D20 PIONEX LTD., P.O. Box 5, Romiley, Cheshire. (Telephone Woodley 2531).

Manufacturers of unit electro-precipitators (8–10,000 cfm) for most applications.

Maintenence and modifications service for existing precipitators.

A17 THOMAS POTTERTON LTD., Cavendish Works, Buckhold Road, Wandsworth, London, S.W.18. (Telephone Vandyke 7202).

Thomas Potterton Limited will be showing a representative selection of their well known gas and oil-fired boilers.

Stand No.

All Potterton boilers are fully automatic and, once they are properly installed, require the minimum attention from the user. They are sectional boilers made of cast-iron, which is accepted as the best metal for boilers, because of its high heat transfer properties and its long life. In addition, the flueways of the domestic sizes of boilers are coated with vitreous enamel; this helps to prevent corrosion and, as a result, makes cleaning and servicing easier, consequently saving time and money.

Potterton boilers are designed to provide Central Heating and Indirect Hot Water Supply, though special versions of some models are available for the provision of Direct Hot Water Supply. Because of their high thermal efficiency, they give full value for the fuel they burn—this means that running costs are the lowest possible.

They are supplied as complete units with all controls matched and tested and are suitable for use in areas covered by the Clean Air Act.

Full details of the boilers, as well as advice and information on heating, can be obtained on the stand.

D15 PYRAMID PRESS LTD., Publicity House, 41, Streatham Hill, London, S.W.2. (Tulse Hill 1222).

We specialize in the production of high quality publications which are issued absolutely free to the authorities taking advantage of our services. These books are designed to inform property owners of the general provisions of the Clean Air Act and, in particular, their obligations and rights so far as their own control area or smokeless zone is concerned.

These books have a local application and are usually distributed in connection with a local authority scheme.

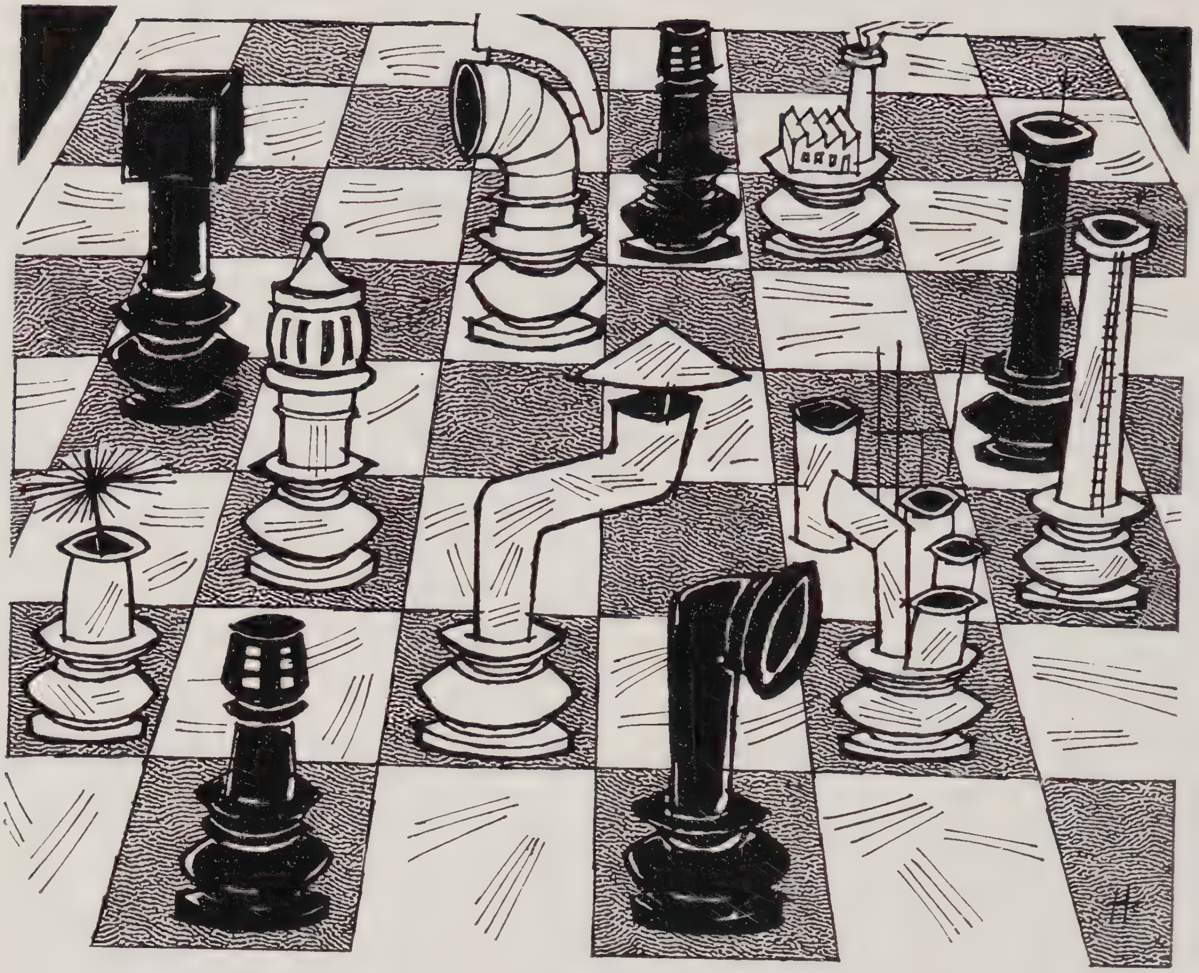
Your enquiries and suggestions concerning our offer and publishing facilities are invited at our Stand.

D12 SANIGUARD APPLIANCES LTD., 62 London Wall, London, E.C.2. (Telephone: NATional 8881/8882) and at Fowler Road, Hainault, Essex. (Telephone: Hainault 4111).

The Barrywald Safety Sanitary Incinerator has now been displayed at all of the Public Works and Municipal Services Congress & Exhibitions since the war in its various forms and has won high acclaim from many thousands of different establishments for the improvements in hygiene achieved for its intended purpose.

Newest developments have produced a higher rate of disposal for a lesser running cost thus making this appliance more attractive from every point of view.

The electrical loading is now set at 1kW. and all components are fully guaranteed for one year and the appliance is backed up by a fully confident service organization which can carry out its efficient activity in all parts of the country.



Clean Air

THE NEXT MOVE

PAST moves have grappled with the problems of smoke, grit and dust.

PRESENT clean flue gases resulting from the use of oil fired equipment still have to be dispersed effectively.

FUTURE clean air problems can best be solved by talking to SHELL-MEX and B.P. Ltd with their experience of over 45 years in the many aspects of oil-firing.

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A1 SHELL-MEX & B.P. Ltd., Shell Mex House, Strand, London, W.C.2. (Telephone: Temple Bar 1234).

Shell-Mex and B.P. Ltd. have thought it appropriate to make as the theme of their stand a demonstration of the fact that there is a petroleum fuel with combustion characteristics acceptable to the provision of the Clean Air Act for use in installations in every type of building, from the factory to the private house.

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At the stand, Shell-Mex and B.P. advisory staff will answer enquiries concerning the industrial and domestic use of oil under the provisions of the Clean Air Act.

B3 SIMPLEX ELECTRIC CO. LTD., Creda Works, Blythe Bridge, P.O. Box No. 5, Stoke-on-Trent, Staffordshire (Telephone: Blythe Bridge 2281/2421)

On display at the Simplex Electric Co. Ltd. stand will be the Creda Grenadier Firelighter, a Creda Centrepiece, a Simplex Radiator and the Creda Caribbean.

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Stand No.

D3 SOLID SMOKELESS FUELS FEDERATION, 74 Grosvenor Street, London, W.1. (Telephone: MAYfair 3327).

The Solid Smokeless Fuels Federation is a non-commercial organization, its work being educational and advisory. It is one of the organizations listed in the Ministry of Housing and Local Government Memorandum on Smoke Control Areas from whom advice can be obtained on suitable appliances, their correct installation and proper operation and the correct type of smokeless fuel to be used in Smoke Control Areas established by Local Authorities under the Clean Air Act.

The Federation's Stand will incorporate a selection of approved appliances burning the range of Solid Smokeless Fuels.

Correct installation of appliances, the technique of igniting and maintaining Solid Smokeless fuel fires will be demonstrated, a panel display will show the areas of availability throughout the country of the individual fuels.

The new brochure " Home Heating For You " and a revised edition of " Clean Air For You " will be available in quantity to Local Authorities for distribution in Smoke Control Areas.

A10 TILGHMAN'S LTD., Broadheath, Altrincham, Cheshire. (Altrincham 4242).

Tilghman's Dust and Fume Control division will be exhibiting full details of their range of high efficiency air filter and dust collectors.

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Stand No.

D10 **THE WEST RIDING CLEAN AIR ADVISORY COUNCIL, Public Health Department, 25 East Parade, Leeds, 1. (Telephone: Leeds 3-0661).**

The history of this Council dates back to 1925 following the Report of the Departmental Committee on Smoke Prevention issued in 1921 which, *inter alia*, recommended that regional advisory committees be established. On the 15th May, 1925, a conference of local authorities in the West Riding was held and as a result, the West Riding of Yorkshire Regional Smoke Abatement Committee was inaugurated.

With the passing of the Public Health (Smoke Abatement) Act, 1926, local authorities were given additional powers and responsibilities, e.g., power to make smoke bye-laws and the Regional Committee, by introducing uniformity and co-operation between the constituent local authorities, exercised a powerful influence in promoting measures designed to eliminate atmospheric pollution.

In 1955 the boundaries of the area served by the Committee were extended to cover the whole of the West Riding (excluding Sheffield) and subsequently the number of constituent local authorities was increased to 84 comprising the following groups:— West Riding County Council. 10 County Boroughs. 12 Municipal Boroughs. 50 Urban Districts. 11 Rural Districts.

In 1957, a new Constitution was approved and the name of the Committee was changed to " The West Riding Clean Air Advisory Council ".

The main objects of the Council are as follows:—

(*a*) To consider all matters relating to Atmospheric Pollution.

(*b*) To secure a better understanding between local authorities, industry, and the general public.

(*c*) To arrange for the provision of information on Atmospheric Pollution to industry and the general public.

(*d*) To keep in touch with all other bodies, National and Local, and with Government Departments engaged in prevention of atmospheric pollution and to collect all information relating to the latest developments in apparatus and appliances for that purpose.

(*e*) In consultation with the various education authorities to organize courses of training for stokers and boiler attendants throughout the area and to encourage the holding of examinations in suitable centres.

(*f*) To make available advice on matters of law and practice relating to atmospheric pollution.

Stand No.

A18 THE WOMEN'S ADVISORY COUNCIL ON SOLID FUEL, 18 South Molton Street, London, W.1. (Mayfair 5358-59-50).

A new handbook, *The Modern Use of Solid Fuel,* has just been published for The Women's Advisory Council on Solid Fuel by Educational Productions Ltd. This book deals not only with the efficient use of solid fuel in modern space heating, cooking and water heating appliances but contains chapters dealing with the Clean Air Act and safety in the home. It is hoped that it will prove useful to all Public Health Officers. Copies will be available on the Stand.

Three coloured Wall Charts dealing with Room Heating, Water Heating and Central Heating with Solid Fuel will also be featured. These would be useful for display in Public Health Departments and Public Libraries. Orders may be placed at the Stand for these charts.

Staff will be on duty to explain the many services given by the Women's Advisory Council on Solid Fuel. These include talks to women's organizations explaining the implications of living in a smoke control area; short Courses in the correct and efficient use of appliances and smokeless fuels for members of the W.V.S., Health Visitors, Home Helps and other interested people, group demonstrations on housing estates and personal visits to old people who do not easily understand the modern use of solid fuels.

Mrs. P. J. Blayney and Mrs. M. Jinks, North Eastern Regional Organizers, will be available to deal with enquiries.

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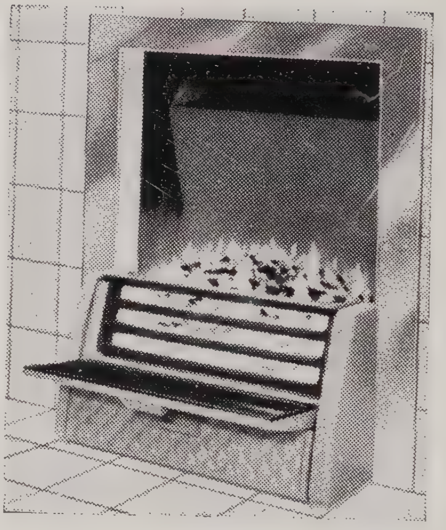

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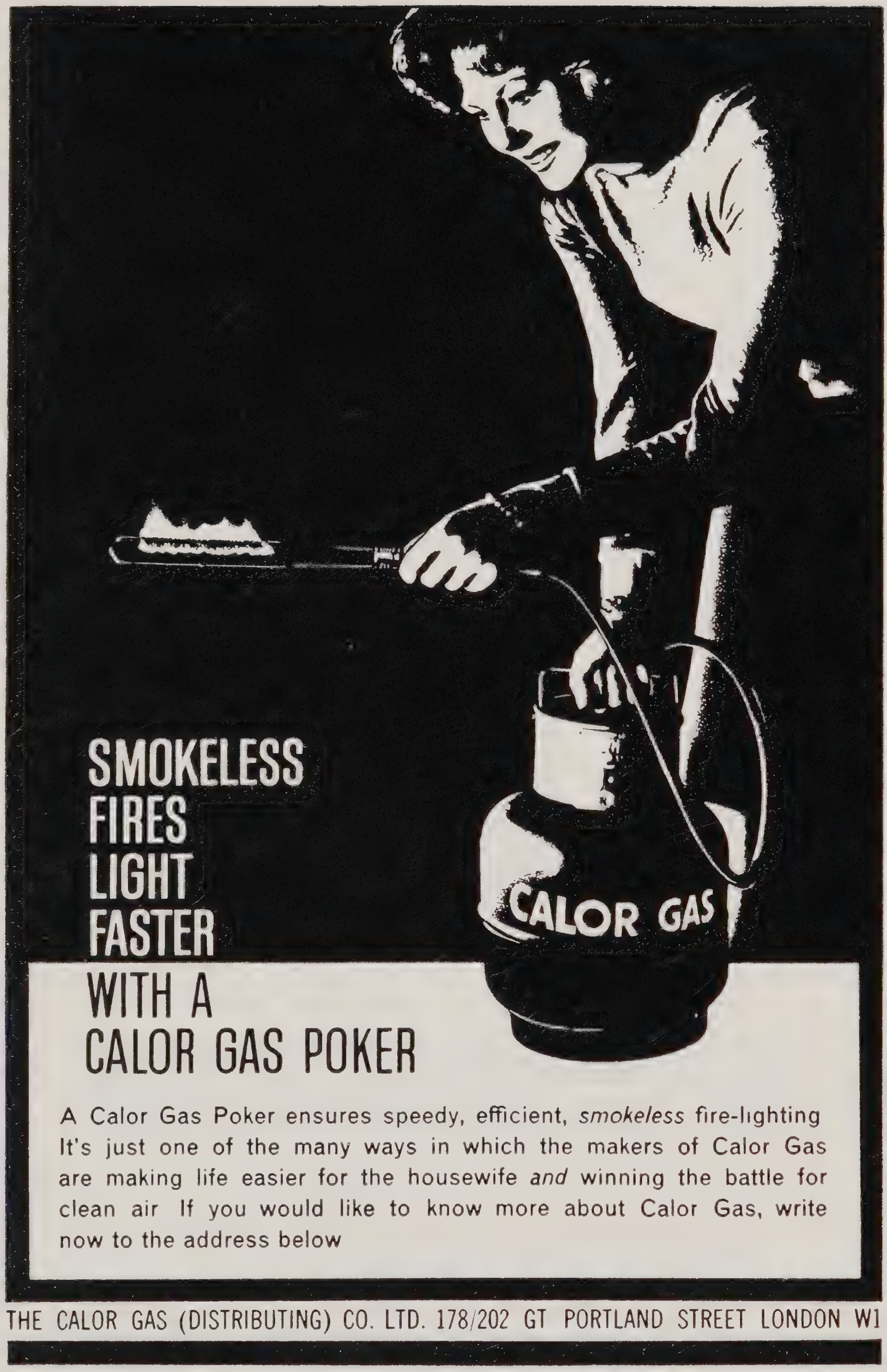

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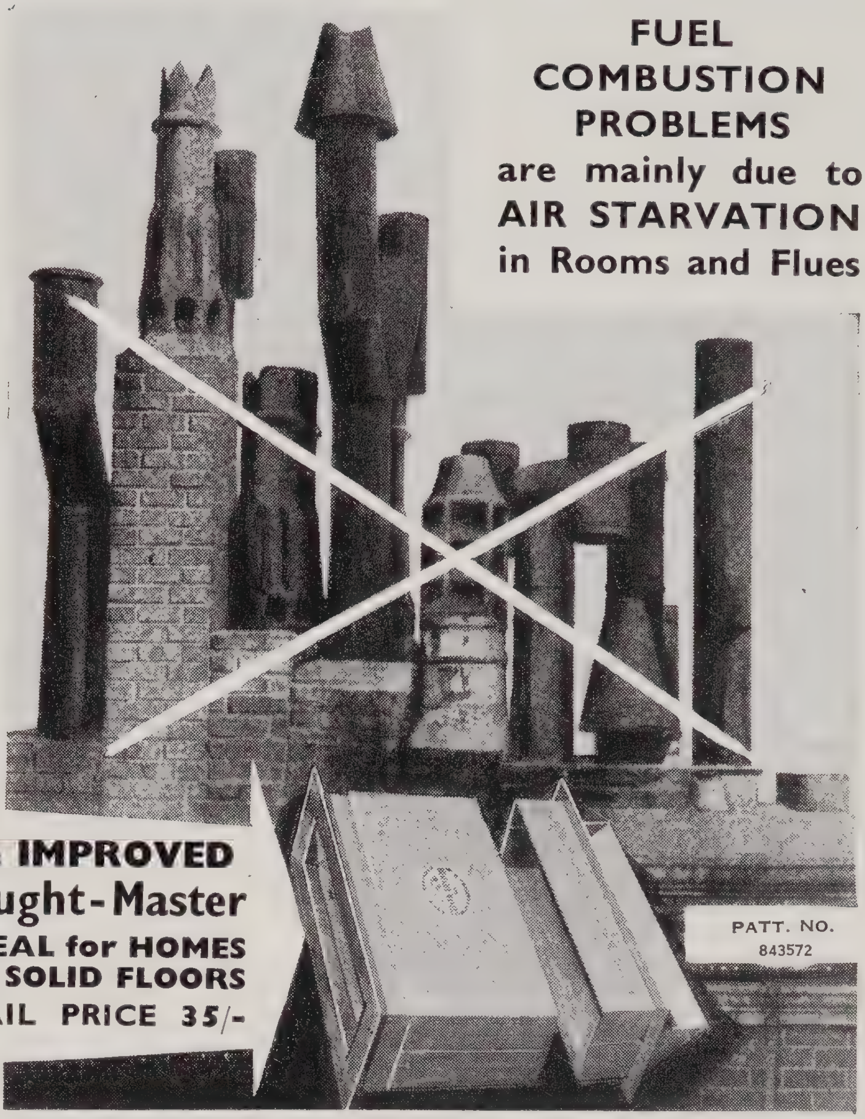

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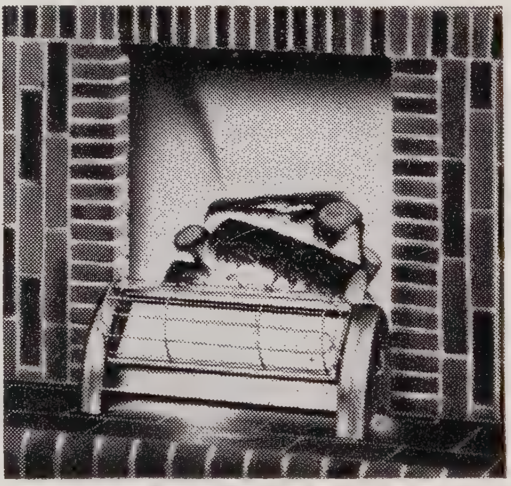

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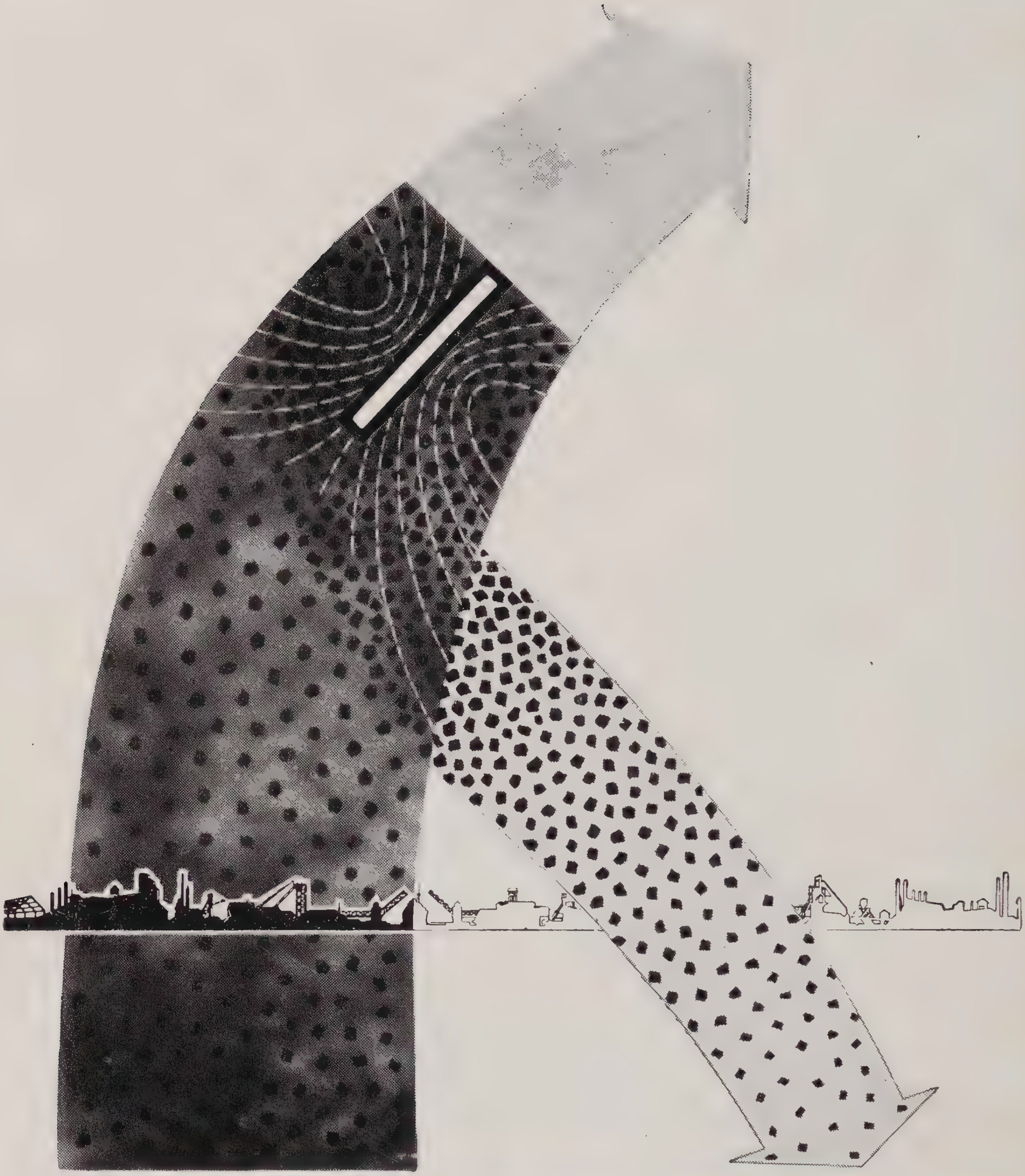

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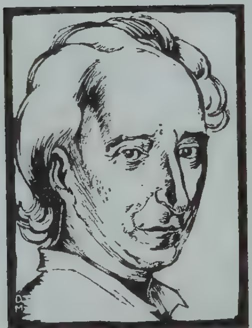
SCARBOROUGH

8-11 OCTOBER



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NATIONAL SOCIETY FOR CLEAN AIR

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8th to 11th October, 1963

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SUMMARY OF EVENTS

THE 30th Annual Conference of the Society was held in the Spa Hall at Scarborough from October 8 to 11. The attendance of members and delegates was 944.

The Civic welcome on the morning of Tuesday, October 8, was no mere exercise in cordialities and courtesies, the Mayor, Alderman W. H. Smith, soon making reference to the Clean Air Act in his introductory remarks. The spread of smokeless zones, he said, would compel the seaside resorts to look to their laurels, and went on to refer to the increasing number of housewives who are determined to keep warm and comfortable by using the attractive modern smokeless appliances now available. He urged the Society to direct its attention to the housewife if we were to be rid of the open coal fire. However, the main appeal must be to the humanity in our people, he said. The evidence that smoke produces bronchitis, pneumonia and cancer and the fact that deaths from bronchitis in this country were the greatest in the world and accompanied by so very much human suffering would strengthen the determination of delegates to make the air of this country as clean as possible.

The opening address was then delivered by the Rt. Hon. the Lord Hastings, Joint Parliamentary Secretary, Ministry of Housing and Local Government. He reminded the conference that a review of current arrangements to ensure the orderly progress towards smoke control was not impeded because technological changes were being instituted and went on to explain the need for new developments in the Gas Industry. Then followed a detailed survey of the history of the Alkali Act of 1863 which provided an opportunity to examine the tremendous efforts made by industry in the ensuing hundred years and the ever vigilant role of the Alkali Inspectors to ensure that these efforts achieved the maximum of grit, dust and fume arrestment.

In referring to the doubling of membership in the Society since the passing of the Clean Air Act in 1956, he expressed the view that far from coming to the end of its work the Society was only just at the beginning. It had, he concluded, an enormous and most important task to fulfil.

Dr. Albert Parker, C.B.E., then delivered his first presidential address and the platform party, led by the Mayor, processed to the adjoining hall to open the largest Clean Air, Fuel Efficiency and Domestic Heating Exhibition in the Society's history.

The afternoon session was devoted to a consideration of the problems confronting domestic smoke control areas and the importance of creating good public relations when their creation was in progress. Mr. Eric Bellingham and Miss M. A. Lovell Burgess presented papers which emphasized their specialist knowledge of the issues involved.

On Wednesday morning, Dr. P. J. Lawther presided over the session devoted to the Human Problem of Air Pollution. The introduction by Dr. Mary Catterall was certainly in line with the advice given by the Mayor on the preceding day that the Society's main appeal must be to the humanity in our people; besides this it was a moving account of the physical suffering wrought by pollution in Leeds. A most spirited discussion reflected both the topicality of the theme and its interest to the gentlemen of the Press.

Delegates were reminded of the Society's continuing concern with the problem of pollution from road vehicles in the latter half of this session when Dr. J. S. G. Burnett presented the report of the Technical Committee.

Wednesday afternoon was devoted to consideration of the present position in regard to industry and the

Clean Air Act. Mr. A. N. Britten surveyed progress in a heavy chemical industry; this paper being followed by an account of the regional activity of the Warwickshire Clean Air Council, presented by Messrs. B. D. Allen, J. G. Calvert and R. K. Crow, it was titled "An Exercise in Co-operation". The discussion that followed reflected the vigilant scrutiny that continues to encourage industry to pursue a 'good neighbour' policy with regard to atmospheric pollution. The Chairman, Councillor Eric Gibbons, presiding over this session, referred to his dual role as a local administrator and as an industrialist.

Mr. J. Goodfellow chaired the Thursday morning session on Research and Development. A crowded platform reflected the wide casting of the net that had taken place to ensure a comprehensive review of the subject. Dr. L. E. Reed and Messrs. C. F. Barrett and S. C. Wallin of Warren Spring Laboratory presented a paper dealing with an experimental chimney operating at the Laboratory. This was followed by an account of developments in the coal industry related to clean air introduced by Dr. A. Alan Taylor of the National Coal Board. The vicissitudes that had accompanied the Gas Council's search for natural gas and underground gas storage were described by Charles Johnson and Messrs. G. N. Stone, and A. J. Clarke of the Central Electricity Generating Board presented a paper on "Power Stations and Clean Air". The session concluded with a paper by Miss M. V. Griffith on "The Application and Performance of Off-Peak Electrical Space Heating in Buildings".

On Thursday, coach parties of delegates visited the Thornaby Works of Head Wrightson and the steel rolling mill of Dorman Long and Co., at Lackenby. Both parties were able to see something of the efforts being made by industry to reduce effluent and the Thornaby party was conducted over the pilot refuse composting plant operated jointly by Head Wrightson and Middlesbrough Corporation.

The afternoon session on Thursday was devoted to films illustrating aspects of clean air in many parts of the world. The programme included contributions from Canada, Czechoslovakia, France and the United States. The National Coal Board film illustrating the solid smokeless fuel process at Birch Coppice, had its first large audience showing at this session.

Grit and Dust Emissions were considered on the last morning of the Conference, Friday, October 11. Mr. T. Henry Turner presided and two papers were presented; the first by Messrs. L. Clegg and W. Short on Technical Aspects and Means of Control and, the viewpoint of a Chief Public Health Inspector, Administrative Problems of Control, by Mr. F. G. Sugden.

At the conclusion of this session the following resolutions were proposed and carried *nem. con.*

(1) Proposed by the Society's Technical Committee:

> "This Conference, having considered a report of the Technical Committee of the Society on air pollution from road vehicles, requests the Minister of Transport:
>
> (i) To introduce regulations under which the fuel stop on all new diesel engines for road vehicles shall be set and sealed at a point below that at which smoke formation may occur; and prohibiting any alteration to the setting except by persons authorized by the Ministry.
>
> (ii) That all diesel-engined vehicles be required to undergo an annual inspection with respect to liability to produce smoke, including the setting and sealing of the fuel stop as for a new engine.
>
> (iii) That control checks of the type instituted by the Ministry in 1962 be continued and extended on a national and permanent basis; and that to make this possible the number of Vehicle Examiners of the Ministry be increased as required".

(2) Proposed by a number of Local Authority delegates for submission

to the Minister of Housing and Local Government:

> "This Conference of the National Society for Clean Air, whose aim is the suppression to a minimum of the atmospheric pollutants, affecting health; conscious of the harm, potential, and practical, to this aim, by the present unsatisfactory position concerning the inadequacy of supply of suitable Solid Smokeless Fuels, and the consequent slowing down of Smoke Control programmes, deplores the progressively deteriorating fuel situation and the Government's failure in providing a realistic National Fuel Policy".

Then followed the moving of the vote of thanks by Dr. W. R. Martine, who referred to Lord Hastings, the Mayor of Scarborough, the officers of the Borough, the President, the Chairmen of sessions, the authors, the stewards, the exhibitors, the staff and all those who had laboured to ensure the success of the Conference and Exhibition.

Besides a Reception given by the Mayor and Mayoress in the Spa Theatre, there was an excellent variety entertainment for delegates. Other social events included coach outings for delegates' ladies to Castle Howard, Rowntrees Cocoa Works and to the nearby beauty spots on the North Yorkshire Moors. A Film Entertainment was held in the Spa Theatre. The "Indian Summer", which persisted for the entire Conference, must have encouraged the veteran delegate who expressed the view that it was "Better than ever!"

Address

by

The Rt. Hon. Lord Hastings

Joint Parliamentary Secretary, Ministry of Housing and Local Government

THIS is a technical conference of specialists who are dealing with one of the subjects vitally important to every man, woman and especially every child, in Great Britain. Most people here will know that at the end of May, the Minister announced that in conjunction with the Minister of Power he was instituting an immediate review of current arrangements in order to ensure that progress of smoke control was not impeded because of technological changes occurring in the gas industry.

Perhaps, without trespassing too far into the province of the Minister of Power, I ought to say a word or two about these changes, in view of some criticism that has been levelled at us, that is, at the Ministry of Housing.

It has been known for a long time, of course, that the gas industry was arranging to reduce its dependence on coal carbonization. You will no doubt recall the reference to this matter in Appendix XI to the Report of the Committee on Air Pollution, better known as Beaver Report, which reads: "The programme of gas production outlined in the Gas Council publication *Fuel for the Nation* involves a reduction in the expansion of carbonization, and consequently of coke production, to the minimum".

What could not have been foreseen at that time is the pace of the change which is likely to be brought about by the increased use of oil and natural gas and which we are only now beginning to be able to assess with any degree of assurance.

The review which we are carrying out could not in practice have been carried out any earlier and we are getting on with it just as quickly as we can.

Some of you may well ask whether these changes could not be halted or even abandoned if by doing so we would be free to continue with the existing arrangements for smoke control areas.

This is the sort of question which has faced us often enough in the past and inexorably stares us in the face as individuals in all walks of life, and as a nation in so many sectors of our economy.

There can be only one answer if we are to survive, and that is that we must be ready to adapt ourselves to the increasingly rapid pace of technical progress if we are to keep our place in the world.

After all, gas is an excellent smokeless fuel and it is in the interest of clean air as well as of the economy generally that we should produce it as cheaply as possible. Changes in the present arrangements may be unavoidable.

Many of you may have come to listen to me this morning in the hope that I am going to make some statement about the progress of the review, or at least to drop some hint about it, but I am afraid I cannot do that today. The Minister will have something to say himself very soon. I cannot anticipate here what he will say. But I would like to give you all from the Minister two assurances.

First of all, an assurance that the Minister will let local authorities know as fast as he possibly can the conclusions reached as a result of the review. He knows perfectly well that local authorities want to know what changes, if any, may be round the corner.

The second assurance is that the whole purpose of the review is to find the best way of ensuring that in changing circumstances smoke control will still go ahead.

The objective, clean air over our cities, very dear to the Minister's heart long before he became Minister, remains the same. It may be necessary to modify previous methods of achieving these ends.

Today, therefore, Mr. President, I am going to talk not about the Clean Air Act but about the Alkali Act.

The Alkali Act

1963 is a landmark in the history of the world's efforts to conquer air pollution because it marks the centenary of the first Alkali Act of 1863. The ground-work was so well laid then that the Act's lineal descendant, the Alkali Act of 1906, is still with us today, and not only with us but more effective and more comprehensive, I believe, than the legislation of any other country in the world in this sphere. We in this country can and should take legitimate pride in our long history of effective control over industrial emissions.

I therefore feel that at your Conference in this centenary year it would be quite wrong for me not to attempt to give you some conspectus of where the Alkali Act and the Alkali Inspectorate stand today.

The first Alkali Act was passed just a hundred years ago—July 28, 1863—and came into force on January 1, 1864. It dealt only with Alkali works, defined as "works for the manufacture of alkali, sulphate of soda or sulphate of potash in which muriatic acid gas is evolved". It required that 95 per cent of this gas should be condensed, a Committee of the House of Lords having satisfied itself from a study of the evidence that this was a practicable possibility. It also required alkali works to be registered and an inspector and sub-inspectors to be appointed. With characteristic caution, the Victorian legislators made the Act serve an apprenticeship of five years, but it survived the test and in 1868 this limitation was removed.

The first Alkali Act is of interest not only as the forerunner of the present legislation but also because it established a principle of "prudent tolerance"—to use a happy phrase of Dr. Carter's, the present Chief Alkali Inspector—which secured the protection of the public without however, stifling enterprise and initiative and so allowed the chemical industry freedom to develop.

If this principle was thought to be justified in the heyday of Victorian prosperity, how much more justified must it be today, when our share of world trade is so much less and our industries face ever-mounting competition from overseas?

Now the Inspectorate's approach is and has always been at once vigilant and constructive, and it has met with the ready response of industry, as the scope of their jurisdiction has widened over the years until it embraces the present wide range of processes (58 in all) I am told, in the chemical, metal, manufacturing, ceramic and allied industries.

Revolutionary developments in the chemical and other industries since the war have transformed what used not so long ago to be laboratory techniques into large-scale commercial operations.

Some idea of the enormous expansion which has taken place in these industries in England and Wales may be gleaned from the following figures taken from the Chief Alkali Inspector's report of 1962:

(1) The manufacture of sulphuric acid (calculated as monohydrate) was over 2½ million tons in 1962 compared with the mere 820,000 tons in 1938;

(2) Production of nitric acid is increasing steadily and is already between 6 and 7 times the pre-war amount;

(3) The throughput of crude and process oils in England and Wales in 1962 was 48 million tons compared with just 2.5 million tons in 1938.

These are enormous quantities, calling for continuous meticulous attention to supervision and maintenance.

The Keynote—Co-operation

The keynote sounded again and again in the Chief Inspectorate's report is co-operation—co-operation with other Government Departments such as the Department of Scientific and Industrial Research, the Ministry of Agriculture, Fisheries and Food and the Ministry of Health; co-operation with local authorities and their officers who are working in a similar field, co-operation with industry and, last but not least, co-operation with the general public for whose protection and convenience the Inspectorate was first appointed.

Let me deal with each of these in turn.

Co-operation with other Government Departments is no doubt something which we ought to be able to take for granted, though examples to the contrary are not unknown. Suffice it to say here that there is the closest working liaison between the Chief Inspector and his professional colleagues in other Departments.

I do not need to tell this audience that close and cordial co-operation with the local authorities and their officers is a paramount necessity. You know it and we know it, and I am sure that there is the greatest goodwill on both sides.

During the past year Alkali Inspectors for instance made 278 visits to works outside the scope of the Act. These were for the most part carried out in collaboration with officers of the local authority concerned, the Inspector's function being merely advisory, the local authority being responsible for any further action arising out of the visit.

District Inspectors have also given talks to local authorities and industrial groups on problems of industrial emissions, and also attended meetings of local joint committees dealing with clean air problems. We are in this business together and the successful administration of clean air legislation demands that there should be mutual confidence and esteem. The tradition of co-operation with industry, as I have said, is as old as the Inspectorate, and as vigorous today as ever it was.

Let me quote you a few examples.

Smelting works, although they are required to register, remain unscheduled, that is to say are not required by the statute, or by any order made subsequently, to adopt the best practicable means for preventing the escape of noxious or offensive gases.

Nevertheless, the industry has adopted on a voluntary and co-operative basis a "best practicable means" for arresting fume and dust, and has installed high chimneys to secure adequate dispersal of sulphur dioxide. Massive pollution of the air by smelting works has ceased, without recourse to further legislation.

In the case of new plant for producing yearly some 80,000 tons of carbon bisulphide, the Inspectorate has been in touch with the company concerned from the pre-design stage.

All matters concerning the treatment of emissions and chimney heights at the Spencer Works of Richard Thomas and Baldwins were discussed and agreed at the design stage and all requirements were met.

There has been close association with the Joint Iron Council in dealing with the difficult problem of emissions from hot blast cupolas. A working party of the industry and the Inspectorate has made an exhaustive investigation of the problems, visiting works where all types of arrestment plant are installed.

There have been discussions with the Central Electricity Generating Board on big power stations to be commissioned in future years. All will be provided with chimneys ranging up to 650 ft. in height, and coal-fired stations will have extremely efficient arrestment plant.

I could go on multiplying examples and showing what they cost, in the case of C.E.G.B. particularly.

These negotiations are inevitably laborious and protracted, making heavy demands on scientific and technical knowledge, and upon the imagination. All must submit in the end to the practical test—will it work? It all takes time and it all takes money—money very well spent indeed, but which still has to be found.

For example, when we think of the electricity supply industry we tend to think of the vast new power stations in comparison with which many of the older stations are mere dwarfs.

Many of these stations have been in service for 30 years or more and all of them date from a time when the standards required for grit arrestment and for chimney heights were much lower than those now set. These stations must still be kept in service in order to deal with peak loads.

The Central Electricity Generating Board has decided to modify or renew grit arresting equipment or to convert to oil-firing at these stations, so as to bring them more into line with modern practice until it becomes possible to dispense with them.. The cost of the approved work at these old stations alone will be about £11 million.

Let no one suppose, however, that the Inspectorate is complacent.

Continuous Reappraisal

In the scheduled industries there is a continuous reappraisal of the standard of emission tolerated hitherto—for example, the standard of tolerance for acid emissions for phosphoric acid plants is being reconsidered; the tolerance for small lead works has been reduced and the traditional figure of the Electricity Commission from a residual escape of grit and dust to air of 0·4 grain per cu. ft. has been revised to 0·2 grain for small to medium power stations and a very much lower, but as yet not precisely defined, figure for the super power stations.

I come last to co-operation with the public.

The Chief Alkali Inspector personally addressed your Annual Conference last year, and I am sure we are all sorry that he is not able to be here today.

He addresses us all of course every year in an annual report with which I am sure most of you are familiar, but in any case, let me commend it to you. In the best sense of the words it is a blue book, but it distinguishes itself from other blue books not only by its red cover, but by its style, which, as a famous Frenchman once observed, is the man.

It is a painstaking review, industry by industry, of the year's achievement with a wealth of technical detail made intelligible to the layman in plain, pungent prose. It contains fascinating accounts of the historical development of great industries, written in a disarmingly conversational style which should not blind us to the great erudition and experience on which they draw.

The whole of the report is shot through with a candour which, as a politician, I can only envy, and with a humour which I cannot emulate. It is clearly a labour of love.

I commend it to you, with all my heart. This is not a panegyric; it is no more than a well-deserved tribute to a great public servant.

The National Society for Clean Air has doubled its members since the introduction of the Clean Air Act, and far from coming to the end of its task is really only just beginning. It is going ahead and particularly in the field of public relations, and with public relations with the people—and as the Mayor said, with the housewife in particular—you have an enormous and most important task to fulfil. Therefore I wish this Conference every good luck in its deliberations and I can assure it that we at the Ministry are very aware of its vital importance, as I said, to every man, woman and child in this country. I am sure your labours in the last few years have had very noticeable effects and in the years ahead I hope that we shall really succeed in getting clean air over much the larger part of Great Britain especially of course in the areas named as "black areas".

Presidential Address

by

Dr. Albert Parker,

C.B.E., D.Sc., F.R.I.C., M.I.Chem.E., F.R.S.H.

THE opening of my address must be to express my appreciation of the honour of being elected President of this Society, whose pioneering work, often in face of ill-informed or commercially interested opposition, has long been a source of admiration, inspiration, and interest to me. The Society has had a succession of distinguished former Presidents. My two immediate predecessors were that eminent physician and scholar, the Rt. Hon. Lord Cohen of Birkenhead, and Sir Hugh Beaver, under whose chairmanship it was my privilege to serve in the work of the Committee on Air Pollution. To follow such outstanding persons is no easy task; but it will be my endeavour to press forward the work of the Society towards providing the people of this country with cleaner air and thus with one of the principal conditions for good health.

On average we each breathe in a day 30 lb. to 40 lb. of air, while we consume only 3 lb. to 4 lb. of drinking water and about 1½ lb. of dry matter as food. That amount of air would occupy 400 to 500 cubic feet and would fill a balloon of a diameter of 9 to 10 feet; it is about 8,000 times the volume of the drinking water and 15,000 times the volume of dry matter as food. Man cannot survive for more than a few minutes without air, whereas he can be kept alive for days without drinking water and for weeks without food. Yet, though we have long insisted on the need for uncontaminated drinking water and food we have only just begun properly to recognize the importance to health of uncontaminated air.

Prior to the passing of the Clean Air Act, 1956, the history of attempts to prevent undue pollution of the air of the populated areas of Great Britain is not one of which this country could be particularly proud. There are records of complaints of nuisance from the emission of smoke from the burning of bituminous coal as early as the thirteenth century, when the population was probably less than 4 millions and the amount of coal consumed was less than one million tons a year. Over the centuries the population has increased to more than 50 millions, the country has been greatly industrialized, and the annual consumption of coal has risen to about 200 million tons. These changes have led to an increase in the pollution of the air, especially in the densely populated industrial towns.

Efforts at various times to mitigate the pollution included temporary local prohibitions of the burning of coal, the deliberations of Commissions and Select Committees, and the inclusion of Smoke Abatement Sections in various Acts of Parliament. Action generally, however, lacked continuous drive and determination. During the last century and the early years of the present century, any picture of a populated industrial area or a factory not showing smoke belching forth from the chimneys was considered to be unreal, lifeless, and a sign of inactivity and probably unemployment. The importance of a factory was often judged by the size of its chimney and the amount of smoke emitted. The industrial areas of the north, including parts of this County of Yorkshire, voiced their pride in their smoking chimneys by the saying "Where there's muck there's money". The truth is that "Where there's unnecessary muck there's waste, inefficiency, and damage to health and property".

In the middle of the nineteenth century, there was a public outcry as a result of the establishment of processes of making sodium carbonate, that is alkali, from common salt. From these processes, which were part of the developing heavy chemical industry, large quantities of corrosive hydrochloric acid were discharged into the air. Following the report of a Royal Commission, the first Alkali, Etc. Works Regulation Act was passed in 1863. To mark the centenary of that Act, there is an interesting article by the present Chief Alkali Inspector, Dr. J. S. Carter, in the Summer, 1963 issue of the Society's Journal *Smokeless Air*. Later, the Act was extended on several occasions and it was consolidated in 1906. Further additions have been made by Alkali Orders, the latest of which was published early in 1963. Under the Alkali Acts, certain processes of a special character, defined in a Schedule of 56 items, are subject to annual registration and to periodic inspection and tests by the Alkali Inspectorate, now under the Ministry of Housing and Local Government. These Acts were a great step forward in the control of the emission of noxious gases and fumes from industrial processes of many kinds. The Alkali Inspectors, who are highly qualified scientifically and technically, have done and are doing excellent work. They have a difficult task requiring not only specialized knowledge but also firmness combined with tact. Before the Committee on Air Pollution drew attention to the need for more Inspectors, there were not enough of them for the amount of work involved. Their work is certain to increase with the changes in existing and the development of new and often complex industrial processes. In 1962, the twenty-eight Inspectors in Great Britain had the task of regularly inspecting more than 3,600 separate processes in more than 2,350 works, and they assisted in other ways in dealing with problems of air pollution.

The major step forward of recent years was the passing of the Clean Air Act in 1956, on the basis of the recommendations of the Committee on Air Pollution under Sir Hugh Beaver, whose reports were published in 1953 and 1954. Under that Act, and subject to the Dark Smoke (Permitted Periods) Regulations, 1958 and the Dark Smoke (Permitted Periods) (Vessels) Regulations, 1958, it is an offence to emit smoke as dark as or darker than shade 2 on the Ringelmann chart. The Act is administered by local authorities and there is provision for appeal to the Minister on certain matters by any person concerned, who is not satisfied with the decision of the local authority. One section enables local authorities to establish smoke control areas, subject to Ministerial approval. Local authorities are also empowered to include in building byelaws the requirement that in new buildings the arrangements for heating and cooking shall be such as to prevent, so far as practicable, the emission of smoke.

There is provision whereby the Minister may prescribe regulations requiring the installation of apparatus for indicating or recording the darkness of smoke emitted. Satisfactory equipment is now available and many industrial concerns have installed smoke indicators, recorders, and alarm bells, though regulations have not yet been issued. It would seem that the time has arrived for making regulations, to come into operation over a period, requiring the installation of such apparatus.

In relation to grit and dust, the Clean Air Act, 1956 requires that furnaces burning solid fuel shall use practicable means for minimizing the emission. All furnaces burning pulverized fuel in any quantity, no matter how small, or solid fuel in any form at a rate of one ton an hour or more must be equipped with plant to arrest grit and dust.

Under Section 10, where plans for the erection or extension of a building, subject to certain exceptions, have to be deposited in accordance with building byelaws, the local authority must be satisfied that the height of any chimney to be provided is sufficient to prevent, so far as practicable, the smoke, grit, dust or gases discharged from becoming prejudicial to health or a nuisance. This is the only provision in the Act in relation to the discharge of noxious or offensive gases, including the oxides of sulphur from the burning of solid fuels and certain oils containing sulphur. There are two good reasons why this is the only provision for dealing with noxious or offensive gases. Firstly, the discharge of noxious or offensive gases from special processes and of sulphur oxides from the combustion of very large quantities of coal and oil at electricity power stations is controlled under the Alkali, Etc. Works Regulation Act, 1906. Secondly, though there have been many investigations of methods of removal of the oxides of sulphur from the waste gases from the combustion of solid and liquid fuels and researches are being continued, the best practicable means of dealing with such gases is by dispersion from a chimney of sufficient height.

The decision on what should be the height of a factory chimney, taking all factors into account, including the local topography, and the position, size and height of nearby buildings, is not an easy one; many local authorities have asked for expert guidance to assist them in reaching a decision. It is gratifying to record, therefore, that useful general guidance is now available in the Memorandum on chimney heights issued in May, 1963 by the Ministry of Housing and Local Government and the Scottish Development Department.

Section 2 of the Clean Air act, 1956 allowed exemption on an annual basis for a maximum period of seven years from the requirements relating to smoke emission provided that the local authority were satisfied that it had not been practicable to make the alterations necessary for compliance with the provisions of Section 1 of the Act. That period of seven years came to an end on July 5, 1963. The time is appropriate, therefore, to review the progress made towards the mitigation of air pollution since the passing of the Act rather more than seven years ago. Firstly, let us consider pollution by smoke.

Smoke Reduction

My own observations in various parts of the country lead me to the conclusion that industry generally, though there are exceptions, has made an effort to improve the efficiency of combustion of fuels with an appreciable reduction in the quantities of smoke discharged. My estimate, or should it be guesstimate, is that for the country as a whole the quantity of smoke emitted into the air by industry is now less than one half of the amount emitted in 1956. This is a tribute partly to industry and partly to the efforts of the Medical Officers of Health and the Public Health Inspectors of the local authorities.

In limited areas, where smoke control orders are in operation as a result of the commendable activities of certain local authorities, there has been a great local reduction in smoke emission from domestic fires. For the country as a whole, however, the rate of progress has been disappointing, in spite of the repeated reminders and spurs to action that the local authorities have received from the Government Departments concerned. It must be a great disappointment, to say the least, to those local authorities that have been energetic in establishing smoke control areas to find that some of the areas are receiving large amounts of smoke from neighbouring districts within the jurisdiction of adjacent authorities who have shown little or no sign of activity towards achieving cleaner air.

At the present time, the domestic grates of this country emit about three times as much smoke as is discharged from all the other uses of coal. Moreover, domestic chimneys are relatively low in height and most of the domestic coal is burned in the winter months when fogs are likely to occur. As a result, the domestic chimney is by far the greatest cause of the pollution of the air by smoke at or near ground level.

With their interim report in 1953, the Committee on Air Pollution provided a map of Great Britain to show what they considered to be the "black areas", that is, the densely populated industrial areas with high frequencies of fogs in the winter. The Committee made recommendations with the object of reducing the pollution by smoke in the heavily populated areas by about 80 per cent over a period of ten to fifteen years. Progress over the first seven years has been far below that rate.

The so-called black areas of Great Britain cover a total in the region of 3,500 sq. miles or about 4 per cent of the area of the country. By the beginning of April, 1963, smokeless zones and smoke control orders were in operation over a total area of only about 280 sq. miles or less than one-tenth of the area that should eventually be covered. Less than 14 per cent of the premises in the black areas, of which 85 to 90 per cent are dwellings, have so far been covered in the smokeless zones and smoke control areas. Some local authorities are moving forward as rapidly as can reasonably be expected, others have tardy programmes with dates for completion well into the 1980's, while at least fifty local authorities in the black areas have not prepared any programmes. These figures show how slow is the progress in dealing with the problem of domestic smoke.

Another method of assessing the rate of progress in the reduction of domestic smoke emission is to ascertain the change in the consumption of bituminous coal in domestic grates. In 1956 the amount of household coal, including miner's coal, consumed in Great Britain was 35·9 million tons while the amount in 1962 was 31·5 million tons, a reduction of only 12 per cent.

With the increase in the population and the number of dwellings, and the demand for higher standards of domestic heating, the coal equivalent of all the fuels used in domestic premises—solid fuels, electricity, gas, and oil—in Great Britain rose from about 67 million tons in 1956 to 78 million tons in 1962, that is by 11 million tons or about 16 per cent. If there had been no change in the proportions of the various fuels used by householders over the period 1956 to 1962, the consumption of household coal of a bituminous type would have increased instead of decreasing. Fortunately, with the growing demand for greater convenience and the need in smoke control areas to use smokeless forms of energy, the annual domestic consumption of electricity rose from 22,400 million to 45,200 million units, of gas from 1,350 to 1,380 million therms, of oil from 0·8 to 1·9 million tons, of the more reactive cokes and Coalite, Rexco, and Warmco from 0·4 to 1·5 million tons, and of Phurnacite from 0·32 to 0·65 million tons. The domestic consumption of anthracite and dry steam coal remained at about 1·55 million tons and that of ordinary gas coke and coke oven coke remained at 3·3 million tons. The increase of about 11 million tons in the annual coal equivalent of the total domestic consumption of fuel and energy and the reduction of 4·4 million tons of household coal, that is an overall total of 15·4 million tons of coal equivalent has thus been met by an increase in electricity equivalent to about 12·5 million tons, oil equivalent to 1·7 million tons and the reactive solid smokeless fuels equal to about 1·1 million tons.

The reduction in the emission of domestic smoke over the past seven years has thus been due to several causes. The principal change has been the growing preference of householders for the more refined fuels—electricity, gas and oil—with their greater convenience and cleanliness, in place of coal. This change has been encouraged by the obvious beneficial effects of the use of smokeless fuels in the smoke control areas, and by the educational activities of this Society. There has also been the effect of the compulsory replacement of coal by smokeless fuels in the smoke control areas. The increase in the use of solid smokeless fuels to replace household coal has been relatively small at only about one million tons a year. If there had not been these changes in the proportions of the various fuels used in domestic premises, with the greater overall demand for fuel the consumption of household coal would have risen and there would have been an increase in the pollution of the air by domestic smoke.

In some districts, the establishment of smoke control areas has had to overcome the organized opposition of those who dislike changes, even beneficial changes, and who have sometimes been encouraged by the propaganda of short-sighted commercial interests. It has on occasion been asserted that smoke control orders are an unwarranted interference with personal liberty. It seems to me that those who insist on polluting the air unnecessarily with smoke are interfering with the liberty of their neighbours who wish to breathe clean air, enjoy good health, and keep down damage to their property. Smoke from chimneys is inevitably carried over long distances, so that the country cannot be divided, as in railway carriages, into small smoking and non-smoking compartments.

Smokeless Fuels

Another argument that has been raised by the opponents of smoke control areas is that there would be insufficient solid smokeless fuel to meet the demands of those who wish to use solid fuel. This cannot yet be a serious problem for the country as a whole, as the increase in the total consumption of all solid smokeless fuels to meet domestic needs over the past seven years was only 1·4 million tons a year. Admittedly, at times of bad weather there have been temporary local shortages of solid smokeless fuels, particularly the more reactive fuels that can be burned easily in any type of firegrate. These apparent shortages have been aggravated by the inadequate storage capacity provided for such fuels in most houses, so that when deliveries are difficult the household stock will not last from one delivery to the next. The remedy for the defect is much greater storage capacity. This is a matter for architects, builders, and local housing authorities. The answer is not the sale of small quantities in paper bags over shop counters, which causes an exorbitant increase in the price of the fuel.

There are certain areas, particularly in the northern region, which includes Tyneside and Teeside, where the demand for solid smokeless fuels suitable for the open fire is greater than the available local supplies. This shortage of reactive fuel is retarding the expansion of smoke control areas. There is no shortage, however, either in the northern region or in the country generally, of the less reactive hard cokes, which can be burned satisfactorily in the modern, but somewhat more expensive openable stoves. Nor is there likely to be a shortage to meet the needs of all the smoke control areas to be brought into operation in the foreseeable future. The extra initial cost of the stoves over the cost of open firegrates is more than counterbalanced by their greater efficiency as heating units. They give much more useful heat than open fires for the same weight of fuel. In addition, they distribute the heat more uniformly over the whole of the room and do not create the draughts of cold air across the room to the fireplace that are caused by the open fire. In consequence, the whole of the room is comfortable in cold weather and not merely a small area around the fireplace. There is little doubt that after experience with the efficient stoves householders would not wish to revert to open fires; but many householders, especially in the north, seem to be reluctant to making changes.

To meet the difficulty in the northern region, stoves capable of burning hard coke have been eligible since June, 1961 for the full grant under the Clean

Air Act; since March, 1962 other appliances that burn hard coke have also been eligible. This is a move in the right direction, which should be extended to all areas. Householders must be convinced, however, that stoves provide better heating than open fires if rapid progress is to be made. To this end, the local authorities, the producers of the less reactive cokes, and the makers of appliances that burn such cokes could with advantage co-operate with this Society in educating the public by means of demonstrations, exhibitions, and in other ways.

Sulphur

Unfortunately, no really satisfactory, practicable method has yet been developed for the removal of the oxides of sulphur from the waste gases from the combustion of fuels containing sulphur. There have been many costly investigations and researches are in progress. It may be that a practicable method at reasonable cost will later be developed for treating the gases from large industrial furnaces such as those at power stations. Meanwhile, the best practicable method is dispersion of the gases from a high chimney so that they are dispersed and highly diluted in the air. There is little or no prospect of removing oxides of sulphur from the chimney gases of domestic heating appliances burning fuels containing sulphur, nor of appreciably reducing the sulphur content of solid fuels; and the gases from domestic appliances are discharged into the air at low level. The sulphur content of the oils used for domestic heating is much less than that of the solid fuels, gas is almost free from sulphur, and the use of electricity produces no gases. A great reduction in the emission of oxides of sulphur from domestic chimneys, therefore, can only be achieved by replacing solid fuels by electricity, or gas, or by oils low in sulphur content.

It is sometimes asserted, without any evidence, that the oxides of sulphur are the main pollutants in the air that are detrimental to health. On this question, it is of interest to note the statement in the published annual report for 1956 of the Director of Fuel Research of the Department of Scientific and Industrial Research (D.S.I.R.) in relation to the smog in London early in January of that year. That smog caused 1,000 deaths in the London area. A statistical analysis of the thousands of measurements of the concentrations of smoke and sulphur dioxide in the air near ground level during the smog gave tentative evidence of a correlation between the concentrations of smoke in six London boroughs and the increase in mortality; there was no definite correlation between the concentrations of sulphur dioxide and the increase in mortality. This conclusion, if confirmed, would indicate that a reduction in the amount of smoke in the air should reduce the toxicity of winter fogs in urban districts. Even without such tentative evidence, it is difficult to understand why there have been suggestions that nothing should be done to reduce pollution by smoke until methods can be found and applied greatly to reduce pollution by oxides of sulphur.

Of all the countries in Europe and America of a comparable standard of living, the average efficiency of domestic heating in Great Britain is the lowest; and the pollution of the air by domestic smoke is the highest. It is not surprising, therefore, that the death rate from bronchitic diseases is much greater in Great Britain than in other countries. Bronchitis is known in other countries as the English disease. What is required is a more intensive drive to reduce the pollution of the air of this country by smoke. The Government Departments concerned are pressing forward and so are the enlightened local authorities; but there is too much apathy on the part of many local authorities, and the population generally do not fully realize the great benefits to health and well-being, amenities, and property that would result from cleaner air.

About a year ago, there were

certain irresponsible statements to the detriment of the Clean Air Act, 1956 by individuals and organizations who should have ascertained the facts before they made any statements on the subject. All may not consider the Act to be perfect. Nothing is perfect from the point of view of everyone; but in my opinion the Act is well framed and is a great advance on any preceding legislation with the same general object. If the local authorities make full use of the powers it confers on them, it will lead to much cleaner air to the benefit of the inhabitants of this country, especially those living in the densely populated areas. Since the passing of the Act, as I have already said, there has been a considerable reduction in the emission of smoke by industry, but only a 12 per cent reduction for the country as a whole in the amount of smoke discharged from domestic grates.

The need is to educate the public and those local authorities who are backward in action or apathetic. Here is the task before this National Society for Clean Air, which has done and is doing outstanding work. With greater financial support, which it well deserves, it could do more.

Of the many important problems of air pollution, it has been possible for me to refer to only a few of them, but there will be discussions on several topics in the later proceedings of this Conference. But before concluding this address, reference should be made to the emission of dense clouds of black smoke from the diesel engines of many road vehicles, which has been the cause of numerous complaints by road users. This is a problem to which the Society has given special attention during the past year, with the generous guidance of experts in the subject. Diesel engines, when properly maintained and operated and not overrated achieve almost complete combustion of the fuel and do not emit black smoke. The Ministry of Transport have been most helpful in arranging for their inspectors to make surveys and stop offending vehicles. Before a licence to operate a motor vehicle over five years old can be obtained, the vehicle has to be tested annually for roadworthiness in certain respects and a certificate of test has to be produced. It would be a step forward in dealing with the smoke nuisance if there were annual tests of the diesel engines of road vehicles before licences are issued to ensure that the engines are adequately maintained and do not emit black smoke.

Lastly, I wish to record the Society's and my personal appreciation of the good work of the several Government Departments concerned with the problems of air pollution. In this, I include the officials, who by tradition must remain anonymous, and whom we have always found to be friendly, easy of approach, and helpful.

Smoke Control

(1) SMOKE CONTROL AREAS AND THEIR PROBLEMS

by

*Eric Bellingham, O.B.E., Ll.B., L.M.T.P.I.**

SUMMARY

The similarities between the campaign for clean water, led by Sir Edwin Chadwick in the last century, and that for clean air, are shown and tribute is paid to the services of elected local government representatives. The implementation of the Clean Air Act, and the smoke control area situation are examined. The value of regional administration is discussed, and reference is made to the example of Sheffield and district. Aspects of the solid smokeless fuel situation are considered and it is urged that conversion grants on openable stoves (fires behind glass), together with the new efficient gas convectors should be made available generally. It is also suggested that the improved grant scheme could be integrated with the implementation of clean air programmes.

DESPITE the quite dramatic advance during the last decade towards a wider understanding of the problems associated with air pollution, the temptation is still almost irresistible to approach a discussion of any aspect of the problem by re-stating some of the basic factors that have given rise to the growth of the Clean Air Movement from that small band of devotees in 1899 to the authoritative national organization under whose auspices we are meeting this week in Scarborough.

However, the title selected for this session of the Conference leaves me little room for manoeuvre. The phrase "Smoke Control Areas" anchors me firmly to the 1956 Act and the problems arising from its implementation. Furthermore, I have been asked to concentrate upon the problem of local authorities in carrying out their administrative duties under the Clean Air Act.

This leads me at once to recall a quotation from the Beaver Committee Report on Air Pollution:

> "Air pollution on the scale with which we are familiar in this country today is a social and economic evil which should no longer be tolerated and it needs to be combated with the same conviction and energy as were applied one hundred years ago in securing pure water".

In the Chadwick Lecture, delivered by Sir Hugh Beaver in 1955, Sir Hugh recalled the dedicated service of Sir Edwin Chadwick from the early 1830's up until the passing of the Public Health Act, 1875. It was the provision of a ubiquitous water supply and adequate domestic drainage in the rapidly expanding areas that became the target of much of the propaganda so successfully stimulated by Chadwick's work, leading also as it did to the establishment of the basic local government structure as it still exists today. Sir Hugh, in his Chadwick Lecture, drew a powerful comparison between the enormous public investment that was represented by our modern water supply and drainage systems and the much smaller investment that would be involved in achieving pure air in the "black areas" even more rapidly than seems to be regarded as adequate by those wholly committed to the fulfilment of a clean air policy. On the other hand one must remember that it took Chadwick all of 40 years to reach the target represented by the Public Health Act, 1875 and that even now, nearly 90 years later, there remain in England and Wales about 700,000 households without a separate piped water supply.

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It was the realization that the epidemics of cholera and typhoid, with their appalling death rates, were the consequence of impure water supplies and inadequate drainage facilities that gradually brought about the necessary legislation which could pave the way to an amelioration of the terrible sanitary conditions that had until then been accepted as an inevitable concomitant of rapid industrial expansion and the 19th century growth of urban communities. Set against this background, the achievements of the propagandists, the central government and the local authorities during the eleven years that have followed the smog disaster of December, 1952, became a matter of pride albeit a challenge to still greater and more rapid progress towards clean air in the "black areas".

It was in 1842 that Edwin Chadwick produced his famous Report on "The Sanitary Conditions of the labouring population" which led to the passing of the adoptive Public Health Act, 1848. Despite what must have seemed to be the obvious benefits that would follow in urban communities, there was not infrequently fierce and sometimes sincere opposition to the local proposals for the adoption of the 1848 Act. A perusal of the reports of the public enquiries that preceded the formal application of the Act to a particular district discloses the inherent resistance of the average Englishman to imposed standards of behaviour. Powerful arguments were advanced to demonstrate the impossibility of so ordering a densely populated urban community as to ensure that supplies of potable water would not be wilfully wasted, and the provision of domestic sanitation rendered ineffective by ill-usage. Chadwick's patience and persistence gradually overcame local opposition. One saw also the emergence of freely elected local Boards of Health which provided powerful local agencies for the implementation of basic standards of equipment and performance. At the same time the provision of piped potable water supplies came to be accepted as part of the normal pattern of urban life.

The Elected Representatives

But never let it be forgotten that the real motivation that translated Chadwick's ideals into practical realities came from the dedicated voluntary service of the hundreds of elected members of the newly created local authorities. The 1842 Report having been accepted, the 1848 Act enacted, the local Boards of Health established, it still required the drive and corporate zeal of the elected representative to ensure that reasonable progress was maintained towards the fulfilment of Chadwick's ideals.

And so it is with Clean Air. I realize, of course, that the modern trend, in this as in other facets of public life, is to emphasize a sense of criticism of, rather than gratitude for, the sincere and, often, distinguished service of, for example, local councillors and aldermen: indeed even local government officers have been known to become a little irascible about the unreasonable pressures they feel are sometimes exerted by sectional interest in the Council Chamber and Committee Rooms. However, looking back across the 20 years I spent in the local government service, my main recollection of the elected representatives is of a body of men and women who, although motivated by a wide variety of political beliefs and social standards, became very largely a coherent body when facing the day to day problems of local government across the Committee Room table. Sir Edwin Chadwick, Sir George Pepler, Sir Hugh Beaver—each fulfilled a critically important task in preparing the way towards a clearer understanding of the social problems about which they felt so deeply and in helping to shape the embodiment of their ideals in the Public Health Acts, the Planning Acts and the Clean Air Act respectively. Thereafter, however, it is upon the elected representatives and their officers that the responsibility falls for carrying out the tasks that Parliament has defined.

Before examining some of the reasons that have prevented much more rapid progress towards the achievement of the targets that were in mind at the time of the Beaver Report and the 1956 Act, it is well to record the progress that has in fact been achieved. The Ministry of Housing published in December last a summary of programmes submitted and target dates recorded as at 31st December, 1961. By that date 13·8 per cent. of the premises in the "black areas" had been covered by smoke control orders confirmed or submitted for confirmation. The percentages, by regions, at that date were as follows:

Northern	7·5
East & West Ridings	13·5
North Midland	6·0
Greater London	22·3
North West	13·4
Midlands	6·9
South Western	9·7
South Wales & Monmouthshire	0·2

It is, I feel, only fair to emphasize that there is very strong local feeling in South Wales that smoke control is unnecessary because of the general use of low volatile coal in that part of the country. Of the 325 local authorities in the black areas, the target year for completion of their clean air programme varied from 1962 (Holborn and Stoke Newington) to 1989 (Solihull) whilst 10 authorities gave no target date and 54 authorities had not even submitted any programme at all. Fifteen of the 28 Metropolitan Boroughs set targets for completion of their clean air programme before 1970 while only 15 of the 53 outer London authorities did so. The figures for the other regions were even less encouraging. Target dates for completion in the 1960's were recorded by only 1 of the 24 authorities affected in the Northern region, 3 out of 52 in the East and West Riding, none out of the 22 in the North Midlands and 1 out of 30 in the Midland region. In the North Western region the figure was 14 (including the City of Manchester) out of the 84 authorities in the region's black areas. However, my pride as a Lancastrian must not prevent me from recalling that the City of London, under its private Act, became the first local authority to be wholly covered as a "smokeless zone".

It should be remembered that by far the greater number of buildings included in the black areas are domestic premises. A good deal of the resistance to implementing the Act appears to spring from ill-informed opinion amongst householders about the incidence and effect of industrial atmosphere effluents. Much greater publicity would seem to be required about the important work of the Alkali Inspectorate as well as the successful efforts of boiler manufacturers and fuel technologists to increase the efficiency of combustion in many industrial processes, thereby reducing quite dramatically the emission not only of the noxious gases and fumes but also of the smoke, grit and dust. I have no doubt there is close liaison between the Alkali Inspectors and the Public Health Inspectors: in my view, however, increased co-ordination of their respective operations, particularly in the field of publicity and public relations, could do much to soften this particular barrier of resistance to clean air programmes in residential areas.

Regional Control

Another beneficial side effect that might flow from closer co-ordination between the Alkali Inspectorate and Public Health Inspectors would be a greater tendency to examine the clean air problem on a regional basis. In many of the conurbations that comprise some of the worst of the black areas there is a real need to plan a progressive clean air programme for the region as a whole. Despite the increasing co-operation of neighbouring local authorities in their approach to common problems, one gains the impression that so far as air pollution is concerned there is a tendency always to place the blame on the neighbouring borough of X or the Urban District of Y rather than to concentrate on one's own contribution to the solution of the overall regional air pollution problem.

The recent renewed attack on the somewhat parallel problem of slum clearance provides a useful guide. The special local office established by the Ministry in Manchester will undoubtedly prove of great assistance to individual housing authorities in the North of England, especially by minimizing the complexity of the administrative procedures involved in getting financial approval to particular schemes. A somewhat similar system of devolution for the clean air programme could not only ensure that a regional programme was devised and implemented in a logical sequence but at the same time could bring about an acceleration of the necessary though frustrating administrative procedures with which we are all so familiar whenever government approval and government grants are involved.

One feels also that there may be some merit in examining the potential of the consortium approach that has proved so successful, for example, in the field of school and university building programmes and the somewhat similar approach to the local authority housing problem represented, for example, by the Sheffield, Leeds, Hull Consortium.

Sheffield

And mentioning Sheffield recalled to me the pioneering work that was commenced over 30 years ago by the Sheffield and District Joint Smoke Abatement Committee. One of my earliest activities in the local government service was to attend meetings of that Joint Committee with the representatives of Rotherham County Borough and to be drawn under the spell of that dynamic enthusiast, James Law. His single-minded approach to his task and his complete dedication to the fulfilment of his ideals reflect the true character of the local government officer at his best. In this connection I remember being one of a group of English local government members and officers in 1946 who went to Germany to give a series of lectures to German local government people shortly before their first post-war democratic local elections. My function was to explain the place of the local government officer and, particularly, the Town Clerk, in the English system. My audiences were obviously puzzled as to how a Town Clerk could operate as the Chief Executive Officer without being personally involved in what sometimes seemed to be the jungle of local politics. It made me realize how subtle is the distinction between the type of official who blindly carries out the orders of his superiors and the English local government officer who performs his duties within the broad policy laid down by his Council but who also, in doing so, reflects his own personality and individual skill. Sheffield were indeed fortunate in having James Law as their Smoke Abatement Officer in those formative years. Similarly, in the co-ordination through Joint Committees of town and country planning as well as rail and road passenger transport, Rotherham and Sheffield undertook invaluable pioneering work back in the 1930's: and Sheffield's recent outstanding contribution to the solution of the problems of slum clearance, housing and urban renewal, under the guidance of its distinguished City Architect, J. L. Womersley, matches its earlier pioneering work in the clean air movement.

One has only to look down on the smoke laden atmosphere of an industrial conurbation to realize that individual local government boundaries become meaningless in such circumstances. If the elected representative can increasingly think in terms of the region rather than the parish, if the local government officer can approach his duties with the single minded dedication of a James Law, and if the Ministry can co-operate in canalizing and thereby simplifying its administrative procedures through the establishment of *ad hoc* regional clean air offices, considerable progress could be made towards achieving much earlier target dates for the completion of clean air programmes in the black areas.

Aside from the apathy, suspicion and administrative difficulties that account in no small measure for the lack of overall progress towards effective smoke control, perhaps the most serious barrier to progress is the fear that a shortage of solid smokeless fuel might cause a breakdown of a smoke control order and thereby jeopardize the long term fulfilment of a clean air programme.

The Image of Coke

Despite the remarkably successful efforts between the wars of the Gas Light and Coke Company and the London and Counties Coke Association to promote the use of gas coke in domestic appliances in the South East, there remained by and large the old image of coke as "coal with the goodness taken out of it". Indeed in my childhood in North East Lancashire the use of coke domestically was regarded as extremely *declassé* unless one had a greenhouse or a central heating boiler. And in the 1930's one recalls the long queues of aged persons and unemployed waiting with old perambulators outside the local gasworks in Stockton to acquire cheap coke, by the bushel, from what was called "the heap".

Although the premium solid smokeless fuels will always command a ready sale in smoke control areas in what is known as "the best end of the trade", it seems unlikely in the foreseeable future that these fuels—even with the accretion of the long awaited Bronowski bullets—can satisfy more than a relatively small proportion of the demand that will arise to replace the domestic bituminous coal used in the black area.

Here again, however, even better publicity and public relations could help the local authorities to accelerate their clean air programme, if security of domestic supplies of standard coke such as Gloco could be assured. There is at the present time a widespread assumption amongst the general public, and indeed amongst many local authorities in the black areas, that the present policy of the gas industry with its seeming emphasis on the use of feed stocks other than coal, such as butane, propane, methane and naphtha, is leading towards a rapid decline in the production of coke by the industry. I appreciate that the local authorities are conscious of the tremendous sales pressure towards the use of gas or electricity for space and water heating in smoke control areas and, of course, with increasingly efficient appliances, both have their part to play.

The fact remains, however, that the bulk of householders in the black areas still yearn for the flame and flicker of the open fire and are still conscious of the economy that flows from the use of solid fuel in modern appliances. But the modern open fire or coke grate needs a re-active solid smokeless fuel. One has the greatest sympathy, therefore, with the harassed Public Health Inspector and his local authority when faced with this dilemma: the temptation to slow down the clean air programme must sometimes seem almost irresistible.

At this point I am reminded of the distinguished work of the late Dr. Hartley who was for so many years closely associated with the clean air movement. It was under his leadership that there was developed by his Group after the last war an open convector fire, operating on the down-draught principle, which could burn small sized bituminous coal virtually without smoke. Unfortunately its smokeless burning depended to some degree upon the operation by the user of two draught controls and it was felt by the authorities that that mythical householder "Mrs. Jones" could not be relied on to operate the controls at the right time in a smoke control area.

Hence it was not accepted as an "exempted fireplace" under S.11 of the Clean Air Act, 1956. However, Dr. Hartley's other application of down-draught burning of bituminous coal—in a furnace linked to a 35,000 B.th.u. ducted warm air system—was indeed accepted as an "exempted fireplace" under the Act and may still be used, burning bituminous coal, in a smoke control area.

Professor Thring's later work in the same field may yet point the way to the approved use of bituminous coal in an individual room heater in a smoke control area. Meanwhile, it is pleasing to record the recent successful launching of an 80,000 Btu domestic warm air unit using bituminous coal smokelessly through an underfeed stoker. Furthermore, the Coal Board's action in stimulating renewed study of coal fired district heating schemes may before long play a part in achieving clean air in the black areas.

Fires Behind Glass

There is, however, another significant contribution by domestic appliance manufacturers to the solution of this problem of the continued use of solid fuel in smoke control areas and at the same time retaining for "Mrs. Jones" the flame and flicker for which she yearns. I refer to the so-called "open fire behind glass". When used with ordinary gas coke or indeed with the hard coke so successfully marketed by the N.C.B. and the other producers under the brand name "Sunbrite", these glass fronted stoves operate at extremely high efficiency, provide a wholly satisfying "flame and flicker" and, moreover, can take care of the domestic hot water demand and, indeed, some so-called selective central heating as well. With Sunbrite in ample supply—at reasonable prices—these stoves could resolve many of the doubts and anxieties expressed by local authorities in the black areas. But one major difficulty remains to be overcome. Only in the Northern region do these stoves rank for the 70 per cent grant. Given a ubiquitous availability of the grant in all smoke control areas, much of the anxiety about availability of solid smokeless fuels could be resolved.

Furthermore, if the improvement grant scheme could be integrated with the implementation of a clean air programme, an owner seeking an improvement grant to modernize a house in a proposed smoke control area would become entitled to a 70 per cent grant for the installation of an open fire behind glass, earning the normal 50 per cent grant on the rest of the approved improvement.

My well known attachment to solid fuel must not prevent me from suggesting that the 70 per cent grant might appropriately be available also for the extremely efficient new gas convectors that are now on the market: especially the glass fronted ones.

I feel the appliance manufacturers have by and large, made a notable contribution to the solution of some of the problems besetting local authorities in seeking to implement the Clean Air Act. It is also fair to mention that the anxiety felt by many local authorities and householders about the contribution to atmospheric pollution of diesel and petrol exhaust fumes from motor vehicles seems now to be receiving serious attention by the manufacturers concerned.

I hope I have said enough to record my conviction that the enthusiasm and diligence displayed by local authorities and their officers is well matched by that shown by the various fuel interests and the appliance manufacturers; and that a swifter achievement of clean air targets in the black areas is not only desirable but is indeed attainable.

(2) THE IMPORTANCE OF PUBLIC RELATIONS

by

*M. A. Lovell Burgess**

SUMMARY

New approaches to the public on clean air are suggested, with attention being given to personal motivation. Encouraging trends in domestic heating and their value to clean air, are noted and attitudes to coke are examined. Against a realistic background the subject of clean air can be seen to be a part of the needs for the completion of the modern way of living.

NATION wide experience as a lecturer in presenting the subject of clean air to ordinary citizens, whether men or women, has convinced me, where the Clean Air Act is concerned, of two things: (1) there is very little active opposition to its implementation; (2) there is a very real, individual apathy.

Clean air is a national policy, officially approved as being in line with the great Public Health measures of the last century and a half. People expect pure water supplies, good sanitation and clean handling of food. And yet—considered apart from a nucleus of dedicated supporters—there is only one aspect of clean air which really compels the reluctant interest of the average person, and that is whether his, or her, street is likely to become part of a smoke-control area and, if so, how soon.

Side by side with this state of affairs is a widespread, eager interest—encouraged by the exigencies of last winter—in the whole subject of house heating. And, except in a few highly industrial towns, it is the smoke from our domestic chimneys which is the biggest source of air pollution.

Considering these two apparently unrelated facts, I began to wonder if the presentation to the public of the subject of smoke prevention had become over the years too negative, historical, abstract, academic; too weighed down by statistics.

Had the time come, in presenting the subject to ordinary citizens, to project a new image; to strip away unreality; somehow to integrate personal, private motivation with public policy?

Would it be possible, in speaking on the subject of clean air, to substitute a simple, positive approach based on everyday observance of social and domestic trends, and to induce listeners to get into the habit of looking for the ill effects of smoke in their own homes, and their own lives?

With this end in view it became interesting to examine the varying attitudes of local communities.

It was easy to understand the cheerful by-passing of the whole subject of clean air by the people living in the little towns in, say, the Rhondda Valley. One could appreciate the reluctance of a Local Authority in the Midlands or the North to submit a clean air programme to the Minister when there were many miners, with their free coal, living in the area,

It was harder, however, to understand why one found a greater degree of receptivity for the subject in, say, Harrogate and Bournemouth than in Heckmondwike and Oldham.

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* Lectures Officer to the Gas Council.

Or was it that all attitudes, whether positive or negative, were determined, quite simply, by varying forms of self interest, whether communal or personal?

Clean air, in a clean town, may be valued by hoteliers, boarding-house keepers, and local professional and business men, as a valuable part of their town's amenities, to be encouraged and preserved along with the municipal flower beds.

Conversely, many people in black areas have an instinctive belief in the axiom that "where there's muck, there's brass".

Personal Motivation

In a world of increasing automation, rivalries, aggression, anxiety, crowds and noise the average family take refuge in their home, with or without a garden, as a retreat from that world, and regard their car, if they have one, as a welcome extension of their private living-space.

There is at the same time—and it is possibly an end product of a surfeit of commercial mass media, oral and visual—an increasing scepticism regarding any hand-out of public information, including clean air statistics.

Does it really help to create a climate of opinion in favour of clean air to tell an average audience that smoke pollution costs the country annually some £250,000,000?

One feels that some of the more advanced computers could easily trace the electrical resistance movements set up in the brains of listeners by such sweeping statements.

Four thousand people, we say, lost their lives in one week in London as a result of the great smog of December, 1952.

Are there inner voices in the audience saying silently, but shrewdly, that many of the victims were probably old people, or people already ill with asthma or bronchitis, and that the first north-east winds of January would have hustled them off, anyway?

Perhaps by now we need to tell even that 1952 London smog story from a new angle—its fatal effects, for example, on the prize animals on show that December week at Smithfield. "Strong as an ox" people say. But the prize beasts came to London and, despite towels soaked in brandy, tied round their necks, the smog killed them.

It would be facetious to suggest that a British public might be more concerned with the effect of smog on the lungs of animals, including their own pets, than on their own lungs. But in a world of humans given over to commercial axe grinding, mass publicity, and satire, they might be more ready to accept the mute witness of the animals.

Encouraging Trends

Many audiences can be encouraged in the right direction by being reminded of some of the social and domestic changes which are already helping to bring about a smoke-free Britain.

There are the high flats, shooting up in town after town, where generations of young people will be conditioned to using derived, or secondary, fuels. These young couples are the immediate descendants of people who enjoyed coming home and poking up a coal fire. But it is obviously physically impossible for a family on, say, a tenth floor, to have an adequate private supply of coal or coke.

Central heating, whether by gas, electricity or oil, is making great progress, partly due to advertising campaigns and the potential of an affluent society, but more directly to the advantages of special tariffs and the availability of long-term loans at a reasonable rate of interest.

Simple, everyday experiences can be used, in place of statistics, to convince people that smoke should have no place in the modern community.

Most people can be reminded of the common enough experience of travelling in a train over a viaduct, into a town, and seeing for a few moments level with, or even below, their eyes hundreds of little chimneys pouring smoke into the wet mist of winter.

They can be reminded of painted window ledges, wiped clean in the morning, and looking, by evening, as if black pepper had been sprinkled on them.

Most women know what it is to soak curtains overnight, and to find the water next morning not only black but acrid, with a chemical odour.

Even the frozen snow in the back gardens last winter and spring, bore mute testimony to the reality of deposited impurities in our towns.

There may be someone in an audience who in question time can be persuaded to recall the difference between, say, Kendal in winter and Kendal in summertime; or the view of three Yorkshire towns, seen from Ilkley Moors in Wakes week—a view that almost completely disappears for the rest of the year under the pall of smoke covering the valley.

Approximately eight million women in the country go out to work, and roughly half that number are married. When husband and wife both go to work there is literally no one in that home to keep the home fires burning. If it is winter time they will use a derived, or secondary, fuel while they have their breakfast, and again, when they return home in the evening. Four million married women are not going out to work to produce cleaner skies over Britain, but none the less their activities are helping to achieve this.

Television has done a great deal to break the attraction of the coal fire. It was not so many years ago when people with a little time on their hands, sat down in the front sitting room, or parlour, poked up the coal fire, and sat and looked at pictures in the fire.

Where do they look at pictures now? In that glimmering box on the left or right hand side of the fireplace, or even—if there is central heating—where the fireplace used to be. And, as long as they are reasonably warm while they are looking at a programme, any derived, flexible form of heat suits them very well.

The high cost of employing painters and decorators and, in some towns where there are many housing developments, the impossibility of hiring them for small, isolated jobs, means a great increase in do-it-yourself home decoration. And where people plan and execute their own delicate colour schemes—and never has the blending of subtle colours played a more prominent part in the home than now—they are not likely to appreciate the smoke and soot of a coal fire.

There is, too, the absence of hired help in the home resulting in a continued emphasis on labour-saving appliances.

There are over five million one person households in this country, and many mobile people living alone prefer a quick, flexible, heat that can easily be put on and off.

It is encouraging to audiences—particularly to householders who feel that too much is said about domestic smoke and not enough about the evils of industrial smoke—to outline improvements in the nationalized industries which have led to greater thermal efficiency, and consequent reduction, although that was not the aim, in the emission of smoke.

It is obvious that with electrification and the use of diesels, the railways have made a great contribution to a cleaner Britain. While smoke remained their stock-in-trade the railways could not but be among the worst offenders.

Power stations now burn their low grade coal more efficiently, and grit arresters are in general use. When power stations eventually use nuclear power there will be many areas enjoying purer air. In the Gas Industry over 700 gas works have been closed down, as part of a streamlining process, during the fourteen years of nationalization. This economic integration on the distribution side has resulted in the disappearance of many old horizontal retorts, with their intermittent coal charging, and coke discharging, in favour of central vertical retorts where the carbonizing process is continuous. As a result modern gasworks are now more like chemical plants, with the emphasis on automation.

Reference to the by-products of coal carbonization is helpful in bringing home to the public the complexity and richness of coal. And it can be stressed that these by-products, valuable in their right context, when released by low temperature carbonization in the average domestic grate, from the domestic chimney, are not, unfortunately, lost. They emerge at low level, in the form of tar particles and sulphur compounds, to produce smog under the low cloud ceilings of winter.

Attitudes to Coke

The Minister of Housing and Local Government will not confirm a local smoke-control area until he has been assured that there will be enough solid smokeless fuel—and Local Authorities have based their estimates to date on *solid* smokeless fuels—not only for the moment, but the foreseeable future.

For some years ahead all smokeless fuels, solid or otherwise, will have a definite part to play.

The price of coke is a topic which usually comes up for discussion during question time. It is not generally realized that it takes two tons of coal to make one ton of coke, and that the Gas Industry pays to the National Coal Board a high price for coal because it needs to select coal best suited for the making of gas and good quality coke. And it is fair to add that it is only the price received for residuals, particularly coke, which can make the production of gas by carbonizing coal an economic proposition. Obviously, therefore, the price of coke must be tied to the economics of the carbonization process—assessed against the costs of making gas by other means—and not directly to coal.

It is also right to point out to the questioner that 16 cwts. of coke give the same amount of heat as 20 cwts. of coal.

Possible "fumes" from coke is a subject which seems to disturb women more than men—perhaps because women more often have the daily care of babies, young children, invalids and old people.

It will be remembered that Lord Cohen of Birkenhead, in his Presidential Address to your Conference last year, pointed out "that coke fires emit neither smoke nor tar whereas coal emits both; that it is the tarry smoke from coal fires which is the main source of the aromatic hydrocarbons which are found in town air; and that some of these are known to give rise to experimental cancers".

> "No such smoke arises from a coke fire", said Lord Cohen, "yet one of the objections raised to coke is that it 'gives off fumes', by which is presumably meant sulphur dioxide (SO_2) because of the smell which is discernible under adverse conditions. Yet flue gases from coal show an SO_2 concentration in the early stages of combustion several times greater than the amount of the SO_2 given off from a coke fire. Why then the objection to coke on account of smell? The total emission of SO_2 from equal weights of coal and coke when burnt in a fire are the same. It is probably because the smell of SO_2 from coal is masked by the pungent smoke if there is a down draught. Moreover, Crumley and Fletcher, using an openable stove with the fire-doors open, found that in the early phase of combustion of a coal fire there is emitted up to 100 p.p.m. of sulphuretted hydrogen (H_2S)—a most offensive smelling gas—whereas coke emits only a trace.
>
> "It has been said that the risk of carbon monoxide (CO) poisoning from a coke fire is not a negligible hazard. Yet the flue fumes from both coke and coal show similar concentrations of CO (0·1 per cent to 0·25 per cent). This belief probably derives from coke being more commonly used in free-standing closed stoves which might have leaky flues, but on open fires coke presents no greater hazard than coal."

Obviously grants under the Clean Air Act can only be given on "approved" appliances, but this is the time, following on any expression of doubts concerning the value or performance of coke, when it can be usefully pointed out why an appliance approved for burning coke *is* approved; it must have a deep fuel bed, ⅝th inch bar-spacing, and damper control to enable a flow of air to take the place of smoke in conveying the waste products of combustion up the chimney.

As the Gas Boards are the main producers of coke for domestic use they do everything they can to instruct people in the right way—and there is a right way—to burn coke.

In almost every audience there are some people loud in praise of the performance of coke, but there are many others who, for some reason or other, have complaints. Most of these, however, will disappear if the right type of coke is used on the right type of appliance.

Appliances range from the approved open fire grate to openable stoves.

Many people, women especially, dislike the boiler effect of free-standing, openable stoves but there is, however, one model which fits well back into the fireplace aperture, projecting only three or four inches into the room, and this built-in effect, with heat resisting glass doors, could do much to popularize the openable stove, the cheapest and thermally most efficient—whether free-standing or set-in—form of continuous heat from solid fuel.

An encouraging incentive to this end would be the extension by the Ministry of Housing and Local Government of the permission to Local Authorities—a permission already given in the Northern region, because of the abundance there of hard coke—for the installation of openable stoves to rank for conversion grant.

A similar extension of the grant for gas convector fires would be a very real encouragement to the public to achieve good heating standards in smoke control areas.

Conclusion

Perhaps as a nation we have not yet done enough research into the relationship between the British family and their winter home environment.

We shall never know how much potential human activity was reduced, or lost altogether, by the narrowing of millions of lives last winter in the evening, and at weekends, to the few yards in front of whatever source of heat there was; how much boredom, low morale, and downright illness, were experienced by housewives and other house-bound people, as the result of being cooped up all day in houses besieged by winter, with the temperature well below freezing point for several successive weeks.

We tell ourselves that we are unlikely to experience another such winter, but at least some good has resulted from it, in that all over the country there are many people making at least one resolution; to achieve, this coming winter, the widest possible heat distribution from one heat source. And in the realization of this ambition they are being helped by excellent, illustrated articles in numerous magazines and journals.

Here, then, is our public, indifferent for the most part, to the subject of clean air, willing at any time to burn nutty slack rather than freeze, but genuinely interested in raising the standards of domestic heating in their own homes.

Presented against this realistic background, the subject of clean air can be seen in its correct perspective—a constructive "with it" completion of the modern way of living.

Discussion

Mrs. M. E. Willison, opening the discussion, said it had always seemed to her strange that any steps taken for the improvement of standards of living, be it clean water, clean milk or clean air, should take so long to be achieved. Mr. Bellingham had reminded them that nearly 90 years had passed since the Public Health Act became law in 1875, yet still there were 700,000 households in England and Wales without a separate piped water supply.

They heard, constantly, that progress towards the achievement of the targets hoped for when the Clean Air Act became law in 1956, was disappointing. Yet it was well known amongst the delegates that our great industrial cities had formulated a programme which, in spite of difficulties and frustrations of one sort or another, they still strove valiantly to keep.

Nor should they forget to acknowledge that the City of London, under private act, became the first "smokeless zone", nor that the Metropolitan Borough of Holborn was the first borough in Britain to become completely smoke controlled on December 1, 1962, and that the Metropolitan Borough of Stoke Newington became the second on October 1 last—both under the Clean Air Act.

They might well ask themselves wherein lay the resistance to the implementation of the Clean Air Act. Was it ill-informed opinion amongst householders on many related subjects?

Mrs. Willison agreed with Mr. Bellingham, that the least understood aspect of a confusing subject was the industrial one. The work of the Alkali Inspectorate was almost a closed book to the householder. So it behoved those of them whose work it was to speak or lecture on the subject of Clean Air to emphasize in simple but firm words the changes that had taken place—to quote one of the simplest—the changes in the pottery industry where kilns were now fired by gas or electricity and no longer did one see volumes of black smoke pouring from the mouth of the ovens. Cement works, road transport and British Railways and some government buildings were less attractive matters that still required a good deal of attention.

She felt now, after the years of propaganda for clearing the skies that apathy was not the bogey it was—or if it existed was it not perhaps due to lack of what one might call "personal or local" publicity?

Perhaps one might mention the problem of the mining areas—had they showed how greatly they valued our indigenous wealth from coal?—had they stressed the changes in home comfort? She could not believe that the miner's wife was not as keenly interested as any other woman in having less work and greater warmth—and what about the right of the miners to breathe clean pure air when they came to the surface at the end of the shift? Was there not still present the horror of pneumoconiosis—she hoped if there were delegates present from mining areas they would say that they supported the Clean Air Act and wished to see it implemented in their districts.

By nature, as a race, the British had an inherent resistance to impose standards of behaviour. Could it be therefore, that those of them whose work was directed so closely to making plain the need for Clean Air, had become too involved and bogged down with data that they found it difficult to see the wood for the trees?

Masses of literature were prepared to cajole, coerce, tempt or drive the householder to a better knowledge of how the benefits of living in a smoke control area could best serve the family. Sometimes she felt their literary efforts were too technical and far too wordy—and made a plea for simplicity in presentation. They had excellent visual aids—thinking of colour films and film strips available to all—let them use them more and more to augment their talks and lectures.

Gone were the days when audiences listened spellbound when they were told that smoke pollution cost the country some £250,000,000 annually—they were conditioned now to hearing and reading matters expressed in terms of millions as if they were a mere bagatelle! No, she took Miss Lovell Burgess's point that the approach could be only in practical terms with which they could associate themselves, as ordinary citizens.

The housewife knew all about the eternal cleaning, polishing and washing that went with life in towns and cities; she knew also the need for warmth in the home and wanted only the best for her children.

So perhaps our approach could be directed to slogans such as "Clean Air and Warmer Houses"—a subject that reminded her that, at that moment, the West Riding Clean Air Advisory Council was sponsoring a six months' campaign, supported by the National Coal Board, North Eastern Gas Board, Coal Utilization Council, Yorkshire Electricity Board and the Solid Smokeless Fuels Federation under the title "Clean Air and Modern Heating".

Mrs. Willison said that her federation had, in the last few years, shared stands with housing and health departments of local authorities in "Ideal" home exhibitions—directing public attention to heating and domestic hot water supply where conversion or improvements grants might be given—under the title of "The Local Authority Housing Committee and Health Committee in co-operation with the Solid Smokeless Fuels Federation".

There was no doubt that the thousands of people who visited such exhibitions were immediately impressed by what they saw—every exhibit was realistic and simple in presentation.

She wished to make a plea for more women in the fuel and advisory side of the work for Clean Air. They had had to take a "back seat" as "the little woman in the home" but surely as they were, in the main, responsible for the comfort of their husbands and children, and as more and more women were having to contribute to the cost of their living, what better field could their labours be directed to than helping the housewife by their practical approach?

This bought her, naturally, to speak of the work done by the Women's Gas Federation and the Electrical Association for Women, whose educational courses for students in schools and colleges contributed so much valuable knowledge for the women of tomorrow.

She wished also to draw attention to the comparative newcomer to this field, "The Proficiency Certificate" on the modern use of solid fuel launched last year by The Women's Advisory Council on Solid Fuel—a certificate not only for students of housecraft in schools and technical colleges, but for the housewife.

Speaking of the housewife and the student—was there not more scope for support of the Clean Air cause through television and radio, especially in the Woman's Hour and educational classes for schools? To her this would appear an excellent medium of publicity and she would very much like to know if this approach could be developed through the Society.

She did not propose to speak at length about all the advisory or educational bodies whose help was unlimited where matters of Clean Air and house warming were concerned, nor about the commercial undertakings which were well able to look after their own interests; but to manufacturers of appliances she would say "please let us have not only efficient approved appliances but appliances that are attractive in colour and design". There were still many who said, for instance, that the heating stoves were ugly and cumbersome, though she could think of at least half a dozen—with their glass doors and good design—that she would find it easy to live with.

Lastly, in their appraisal of the present situation of progress to Clean Air there was the question of *fuels*—and she welcomed the Circular No. 54/63 from the Ministry of Housing and Local Government, and dated August 28, 1963, telling them that fluidized char binderless briquettes manufactured by the National Coal Board had arrived. This was followed by a pronouncement by Lord Robens that the trade name is "Homefire"—all they now wanted to know was the price. She welcomed also "Scottish Rexco" made from Scottish coal for Scottish homes. Both fuels were being used in the Exhibition. As they would have read in the Autumn edition of Smokeless Air, the editorial headed "Crisis or Challenge?" set out clearly the present position concerning solid smokeless fuels and the alternatives. She thought it was a brave article that must have given the writer moments of anxiety.

They all knew that the whole fuel situation was giving cause for apprehension, but they must, with what patience they could muster, await the pronouncement from the Ministries of Housing and Local Government and of Power, for she could not help but feel that, after all their deliberations, some acceptable policy would be determined.

In conclusion and to all delegates present—the "converted" as they were usually called—let them spread the gospel by all the means available, let them take courage and go forward to what they knew would be a benefit to all humanity.

J. W. Batey (Sheffield and District Clean Air Committee) said that Lord Hastings had said that morning that the Minister had the cause of air pollution close to his heart, and that the difficulties regarding the supply of solid smokeless fuel would soon be the subject of a statement, but that this was neither the time nor the place to give the answers to the problems. He would remind the Minister that the northern region had been informed about 12 months ago that supplies of reactive smokeless fuel would be difficult to obtain, and he would accordingly increase the grants so as to enable the fitting of openable stoves.

A few months ago the Minister had told the northern region that he could not consider further smoke control areas, unless such areas were based primarily on piped fuels, replacing coal. How long had they to wait for the Minister to pronounce on this subject? The Minister had direct access to the top administrative and technical sections of the fuel industry, as well as the Clean Air Council which was formed for the very purpose of guiding him in these matters; but they were still waiting.

He agreed that the Ministry could not make solid smokeless fuel; they could only bring pressure to bear on the market, and this could only be done by increasing the grant on solid smokeless fuel appliances. Up to now the Ministry had only been interested in the cheapest and most inefficient forms of home heating.

In Sheffield they employed 20 people on smoke control work; they were converting 8,000 houses per annum to smokeless conditions; they were spending £150,000 a year; they were at "go go go!" and if the Minister did not catch them up they would be in orbit and out of his gravitational field and influence.

Councillor T. P. S. Prudham, J.P. (Felling U.D.C.) said he was speaking as Chairman of the Northumberland and Durham Local Authorities' Joint Committee for Clean Air. The Minister's circular regarding the shortage of soft coke in the North-East came as a great shock and disappointment to their members. After the difficult task of overcoming tradition and convention and solving the problem of miners concessionary coal with the help of the National Coal Board and the Miners' Union, they had received this setback. They had had a rough road to travel to achieve the present position. Those authorities contemplating smoke control areas had had deputations from Miners' Lodges and public petitions, and had roughed the storm; and now, when at last things seem to be moving more smoothly, received the Minister's circular. This was in fact "putting the cat among the pigeons". It was looked upon as a minor Dunkirk but they must remember that Dunkirk was turned into victory, and although they had every right to grumble and to criticize, they must still press on with smoke control areas.

In a press report a few weeks ago, after the circular had been sent out to local authorities, it was stated that one local authority on Tyneside would not enforce action in any of their existing smoke control areas. He felt this was wrong because there were escape clauses in the Act so that if persons could not get supplies of suitable smokeless fuel they could contact their local authority and if the authority could not help then no doubt the escape clauses would operate.

Another vital problem in the North-East at the present time was unemployment. When there was full employment people were sure of the necessities required for living such as housing, food and clothing, and at times like this clean air was more readily acceptable as it was looked upon possibly as a semi-luxury and not regarded as a main essential like food, clothing and shelter. When unemployment came there were additional worries and problems and more attention was paid to the basic essentials, with the result that clean air was pushed further into the background.

Another drawback was the high cost of putting in openable stoves instead of adapting the open fire to burn solid smokeless fuel. While one could talk about the greater efficiency and increased heat, the housewife had to look at her purse and to most working people and above all to the old-age pensioner, the actual price of the fuel was the governing factor.

The President had mentioned, and it had already been mentioned that afternoon, that the Northern Region was the only area which had grant on openable stoves. Even with that, installation costs were much greater than those of an approved open fireplace to the tune of between £30 to £40 more. Recently, several persons from the North-East, including himself, met Sir Keith Joseph prior to the now notorious circular being issued. As they were fully aware of the soft coke position, the question of grants was put to the Minister who said that the Northern Region was already getting grants for openable stoves while other Regions did not. It was then pointed out that the increased cost of such an appliance was considerable and as the North-East was a special area for which a Minister, Lord Hailsham, had been specially appointed, could not that area receive special treatment in that as it was one of the blackest areas in the country and as such required the air cleaning, and could not further grant be made to ease the burden on local authorities and allow them to carry on with their programmes as it would seem the increased cost, part of which the local authority had to pay through their rates, was too much for the small authority? The Minister stated that he would see Lord Hailsham on the matter and would also approach the Treasury with respect to the grants.

It was to be hoped that something could be done as, at last, after breaking through the natural resistance to smoke control programmes in the coal-producing North-East and getting local authorities interested and willing to consider smoke control areas, it would be a tragedy if future schemes fell through due to the extra cost to the local authorities. Once the interest which had now been kindled started to wane, it would be a far more difficult task to re-kindle the flame and unless something was done quickly then he was afraid this was what would probably happen.

Dr. Marjorie Clifton (Warren Spring) said that many would be looking, among the results of smoke measurements coming from the National Survey, for proof of the smoke control pudding. There were two points to note when looking for evidence of an improvement in smoke concentrations in smoke control areas:

Firstly, in many places the centre of the city was the first area to be controlled, but city centres where central heating had long been established were to all intents and purposes smoke-controlled before the designation was applied, because few open fires burning soft coal were to be found there, so smoke concentrations before and after control might not differ very much.

Secondly, domestic smoke control areas were very rarely large enough to remain unaffected by neighbouring sources, especially in the worst conditions, when smoke was held down and could drift slowly close to the ground. In spite of this, Warren Spring Laboratory had found that smoke control on a number of housing estates up and down the country had been associated with a reduction, over an 18-month period (two winters and one summer, including the severe cold weather of last winter) of one-third in the average smoke concentration compared with carefully matched nearby areas not under control, even though at least as much fuel and possibly more was used in the smoke control areas. This was shown by the fact that sulphur dioxide concentrations in both types of area were the same. As smoke control areas became more extensive they could confidently expect to achieve much better results than these.

R. Emerson (West Hartlepool) commented upon the serious difficulties which were being experienced on Tees-side following the Ministry of Housing circular of August 1, restricting solid smokeless fuel to hard coke, and asked for consideration to be given to Tees-side being given an equal share of those fuels which were available. If the Ministry could not agree to this, then he did not see why those in the North-East should have to pay more for converting their appliances, and therefore suggested that there should be an increased grant from Government funds. He did not see why the North-East should have to pay more because of Ministerial mismanagement.

He stated that his council had raised the problem of a possible shortage of open fire fuel in 1960 and had been told by the Ministry that there was nothing to worry about, and that part of the answer was that "Warmco" would be supplied by the Coal Board if there was a demand for it. He stated that "Warmco" was not available in his district at the moment and asked Mr. Bellingham "Where is the 'Warmco'?"

With regard to "Sunbrite", which was the only solid smokeless fuel available in the North-East, he pointed out that although it was a good fuel for boilers, stoves or room heaters, many experts disagreed as to its suitability for underfloor draught fires. He stated that although it was a recommended fuel according to the approved list, and many advertisements were appearing in *Smokeless Air* and other journals, the local officers of the National Coal Board and the Coal Utilization Council were not prepared to wholeheartedly recommend its use for this purpose. He asked Mr. Bellingham his opinion of the use of "Sunbrite" on underfloor draught fires and whether the National Coal Board would be prepared to deal with complaints if they arose? He pointed out that this matter was of great importance to the North-East, as it was the only open fire fuel now available in the North-East.

T. H. Marshall (Shoreditch) said that the President in his opening address had stated quite correctly that one of the greatest problems in delaying the progress of smoke control areas was the difficulty in obtaining small quantities of solid smokeless fuel at a reasonable price and the lack of sufficient storage accommodation in numerous homes for solid smokeless fuels. Assuming for a moment that there were sufficient supplies of smokeless fuel to be obtained throughout the country, the immediate problem in tens of thousands of homes was that more accommodation could not be supplied for storing solid fuel because of limited space, that distributors as a rule would not deliver less than 5 cwt., and that the unfortunate occupiers were compelled to seek small quantities of fuel ready bagged, for which they were being charged exorbitant prices.

Mr. Marshall spoke of the measures which would be taken by his local authority, Shoreditch Borough Council, in seeking the co-operation of the remaining London boroughs in an effort to obtain legislation which would give local authorities the power to purchase and distribute solid fuel in small quantities at a reasonable cost if, *and only if*, the coal merchants failed in this respect.

His Council were showing an active interest in the supply of automatic vending machines for the sale of solid smokeless fuels both bagged and loose. One such type of machine had now gone beyond the experimental stages and a prototype was already being used under practical conditions, the result so far being most encouraging.

If these experiments proved to be successful, his Council intended to encourage coal merchants to supply these machines throughout the Borough, and failing this they might also consider providing machines themselves in an effort that adequate supplies of solid smokeless fuels might be made available to those who had insufficient storage accommodation in their dwellings at a reasonable cost.

Mrs. C. Wood (Women's Advisory Council on Solid Fuel) referred to the importance that had been attached to the housewife both in the Papers and in the many remarks made from the platform. She went on to say that the Women's Advisory Council on Solid Fuel was formed 20 years ago during the war years to advise the housewife on the best use she could make of the then available fuel —and now 20 years later 14 Regional Committees existed throughout the length and breadth of the country. The members were representatives of women's organizations, housing, public health, educational bodies, domestic science colleges etc. Briefly, the housewife was helped in the choice of burning appliances and the type of solid fuel to use whether for domestic hot water, cooking or space heating.

Full-time regional organizers were employed and they gave illustrated talks to women's organizations and students, etc., on many topics including the Clean Air Act and its implementation and advice was given on appliances, etc. It was felt that local authorities did not make enough use of the services the W.A.C.S.F. offered. The regional organizers were also available to help with individual problems and would arrange mass demonstrations on request of the type that Miss Lovell Burgess had suggested.

Mrs. Willison had referred to the Proficiency Certificate in the use of solid fuel which had been instituted by the W.A.C.S.F. for the use of domestic science students, demonstrators and housecraft teachers—a section of the syllabus was concentrated on the Clean Air Act. By this means the housewives of to-morrow were being trained in the modern use of solid fuel. The Council had published a book—"The Modern Use of Solid Fuel". Although this was primarily for the use of students etc., it was also of use to anyone interested in architecture, housing and public health.

Councillor W. A. Newman (Ipswich) said he wanted to say a few words on the problems causing much concern to public representatives.

First and foremost was the chaotic state of the fuel situation. Whenever this matter had been raised they were told by high ranking personalities "Don't worry; there are ample supplies of gas coke available and output is increasing. Get on with the job."

Now they were told that gas coke was almost on the way out, one naturally wondered why their advisors could not see this trend earlier. As far as the excellent oil, gas and electric heating systems were concerned it must be realized that to install them in the smaller type of houses would be far too costly for most occupiers. Then they had the vast number of dwellings down for slum clearance, substandard houses, council dwellings, all of which by their very nature were not suitable for expensive conversions. On the newer type of openable stove he declared that it had exceeded all expectations.

He suggested a short pause in their operations and a full scale inquiry to sort out this muddle and confusion. They should call in Lord Robens who had stated there were mountains of suitable fuel. Bring in all the interested parties including the fuel merchants, tell the Ministry they could not proceed unless granted further concessions, then the public representatives could march into battle backed up by the thought all ammunition was there.

Alderman W. L. Dingley (Warwickshire C.C.) said that since the passing of the Act much had been learnt but progress in smoke control had been disappointing—the reasons were well known.

He had been amazed to learn that the D.S.I.R. had been precluded from ascertaining and reporting on how to make the best economic use of all our fuel resources with the fullest regard to the prevention of all harmful and wasteful discharges. He thought the findings would be the complete gasification or conversion of all fuel at the source, and then by pipe or cable to the very points where it was required. The suggested "Liner" hard fuel trains, and non-stop wagon emptying still left all the multi-handling and delivery by road from the rail head, where there was already the most road congestion.

No problem should be looked at in isolation. His plea was for an independent commission with terms of reference already stated.

Authors' Replies

Miss Lovell Burgess, replying to the "stimulating discussion", urged the extension of the 70 per cent grant of the local authority to include the provision of openable stoves and, better still, gas convector room heaters and thus improve, and not debase, the nation's heating standards.

Concerning supplies of solid smokeless fuel, the speaker said that although the gas industry was undoubtedly moving away, to a limited extent, from traditional coal carbonization in favour of gas from oil, and what had come to be known as Sahara gas, the industry would have to use the nation's indigenous coal for many years to come. Also much of the coke which used to be retained on the works for the production of carburetted water gas was, owing to the use of supplementary oil gases, now released for the domestic coke market.

Now, perhaps, was the time to tell the public more about the work being done by the Alkali Inspectorate in reducing emission from industrial stacks, and also, perhaps what the Clean Air Society was doing concerning the pollution of the air by diesel engines. People would then be able to see that action was not directed solely against their coal fire.

Young people, particularly, should be shown that to promote clean air was to be "with it", because so many domestic and social trends were helping to produce cleaner skies over Britain, quite apart from any specific legislation.

The speaker said that she had every sympathy with the delegate who said he had been "sniped at" by schoolteachers, a magistrate, and even from the pulpit, by people who, for one reason or another, did not look forward to any further implementation of the Clean Air Act. In her own experience, as a lecturer on the subject, she knew only too well what it was to have a cordial expression of thanks conveyed to her by someone who, before sitting down, openly voiced his, or her, appreciation of a coal fire.

This, however, was only one more reason for getting into the schools with clean air propaganda—not only for the benefit of school leavers but for children from the age of five upwards, who should be taught clean air principles as a part of modern hygiene.

The delegate from Shoreditch had made a valuable point in stressing the need for greater provision of fuel storage bunkers. Both Local Authority and private builders should keep in mind this very real necessity.

Alderman W. L. Dingley, (Warwickshire C.C.) had bewailed the fact that we had no national fuel policy. If communities could have an archangel to direct them, it would be splendid, but if a fuel policy meant the setting up of another central authority, dictating to the public what fuel it must, or must not, use, its directives would not be welcomed by the long-suffering public.

One delegate had challenged the

continual advertising on behalf of Mr. Therm and Mr. Unit. Advertising, however, in that it represented competition, had the effect of keeping the two great industries, gas and electricity, on their respective toes, and it was the general public which benefitted in terms of better appliance design, and willing consumer service.

Alderman Hammond, of Kingston-upon-Hull, had maintained that people were slow to change but that once they were well informed, and knew the value of a commodity, they were prepared to accept it. That was true. Recently, at Bricknell, in Alderman Hammond's own area, the speaker had been told by several members of the Bricknell Townswomen's Guild that, after experience of open coke fires, and gas convector heaters, they would not willingly return to the use of coal.

Mr. Bellingham said that, having spent over 20 years in local government, he had listened with sympathy and, he hoped, understanding, to the comments about the local problems of solid smokeless fuel supplies and the higher costs involved, for example, in installing these new room heaters (open fires behind glass) that could burn hard coke to produce cheap and efficient heat as well as the flame and flicker for which the British householder yearned. There was clearly a case for making the 70 per cent grants more widely available for their installation. Moreover, it should be emphasized that their increased efficiency and resultant economy in use would to some extent offset the higher installation costs.

Regarding underfloor draught fires, trouble was sometimes encountered when burning hard coke; however this was more often than not due to faulty installation or exceptional local conditions.

Prepacking of solid smokeless fuels had undoubtedly a significant part to play although the extra cost involved—especially when vending machines were used—in some degree offset its convenience. Meanwhile the provision of larger and more convenient solid fuel storage bunkers needed encouraging.

Mr. Bellingham paid tribute to the helpful co-operation displayed by the N.U.M. in dealing with the problem of miners' concessionary coal in smoke control areas.

The long term solution would be the development of open fires behind glass that could burn "singles" smokelessly; pending their arrival, a heavy burden lay on the shoulders of the elected representatives and the local government officials in order to stimulate an ever widening interest in the menace of air pollution and the combined effort that can lead ultimately to clean air in all the black areas. As to the suggestion that the fuel should be converted at source and thence transmitted by pipe, it was interesting to note the N.C.B.'s renewed interest in district heating for high density residential areas and re-developed town centres.

AIR POLLUTION — THE HUMAN PROBLEM

by

*Mary Catterall, M.B., B.S., D.M.R.T.**

SUMMARY

The effects of air pollution on the urban population are reviewed, and a description of the respiratory system is followed by consideration of the influence of air pollution on bronchitis and cancer of the lung. The last section of the paper deals with the psychological effects of air pollution.

BEFORE the Industrial Revolution, the ability to produce goods depended on the muscular strength of men's limbs and backs. But following the outstanding inventions of the eighteenth century, material success became correlated with mining and machines. The winning of coal and its transport and the building of mechanized workshops changed life in England. Coal, coke and the steam engine drove machines which suddenly brought material wealth and power in undreamed of quantities, and the banners of this explosive advance streamed into the sky from the new factory chimneys. The black pall of smoke which formed over the growing towns became synonymous with work, wages and in some cases, with great wealth and vastly improved living standards.

The smoke, which heralded the emergence of industrial England, has extended and intensified in the subsequent 200 years, but its early association with work and wealth has now become a striking correlation with deaths from bronchitis, pneumonia and lung cancer.

Smoke contains particulate and gaseous poisons, some of which are now measured routinely, for example soot and sulphur dioxide. Special investigations in selected towns have revealed measurable quantities of other substances which are poisonous to plant and animal life; these are benzpyrene, hydrogen sulphide, carbon monoxide, oxides of nitrogen and trace elements of which molybdenum, beryllium and arsenic are of significant importance. It would be wrong to suppose that this is a complete list of the poisons in the atmosphere, additional elements being likely to be found in the environment of such places as chemical factories. Fumes from petrol and diesel engines are of growing importance, especially in the narrow streets of old towns, where they are breathed in before much dilution has occurred.

The gravity of the degree of pollution and of our inability to recognize, or measure it completely is illustrated in Figure 1. This is an electronmicrograph which reveals particles from domestic chimney smoke which would be invisible to the naked eye or even to a conventional light microscope. It is only the electronmicroscope which is sensitive enough to reveal webs of carbon particles, hydrocarbons, tar and crystalline fragments of unburned

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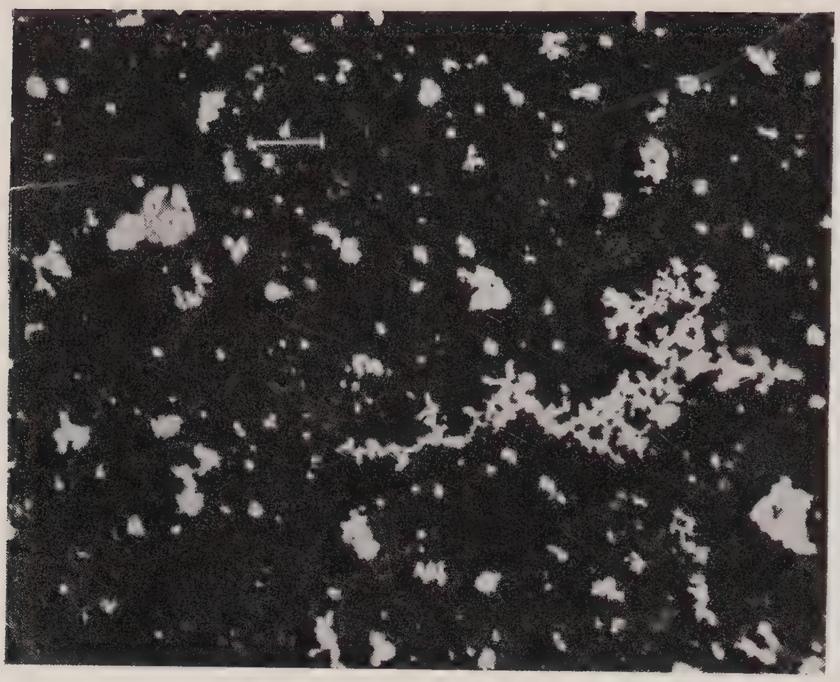

Figure 1. Electron-micrograph of typical particles from domestic chimneys, showing a web of fine carbon particles, hydrocarbons and droplets of tar. The line shown is one micron in length (1 micron = 1/25,000 of an inch).

Photograph by M.R.C.

Description by D.S.I.R

coal. These particles are so small that they remain airborne indefinitely, or until they are breathed into the lungs, where their minute size enables them to penetrate to the deepest parts of the lung and cause irritation or lung cancer or destruction of the fine membranes between the lung and the blood.

The soot, suspended in the air of industrial towns, filters the sunlight and measurements, made in several towns in England and the United States, show that 50 per cent of light is prevented from entering the centres of these cities.

This country is small, highly industrialized and thickly populated and the majority of people—about 40 millions of them—are breathing air polluted from chimneys, traffic and cigarettes. Those in the worst areas are also deprived of sunlight and warmth and their daily surroundings are of dirty, drab buildings, dull windows and narrow streets. Small patches of poor grass, blackened with soot, and trees dwarfed and distorted by poisons are all that relieve the gloom of many a town dominated by the mills of a revolution 200 years old, but which still accounts for much of the wealth of this country today.

The human problem of air pollution is health and this is difficult to define. It is something more than the absence of disease, it is a positive sense of well-being and it depends on the individual's personal relationships, his job, his ability to do his work, his leisure and the surroundings in which he has to live and the air which he has to breathe.

The effects of air pollution on health can, therefore, be considered as those affecting his lungs and his heart and those affecting his psychological state.

The human being is dependent for life on oxygen, and a person must take about 20,000 breaths each day so that 15,000 litres of air from his immediate surroundings reach his lungs and 3,000 litres of oxygen are absorbed into the bloodstream. It would seem that any substance taken in such large amounts, if it was poisoned, must have an effect on the parts of the body where it comes into contact.

Air passes from the mouth, down the trachea, or windpipe, to the bronchial tubes. These divide and subdivide many thousands of times, like the branches of a tree, and terminate in tiny air sacs which are in intimate contact with delicate blood vessels (capillaries) which contain blood pumped to to them by the heart. Oxygen passes across the very fine membrane formed between the air sac of the lung and blood in the capillary. The oxygenated blood is then returned to the heart and

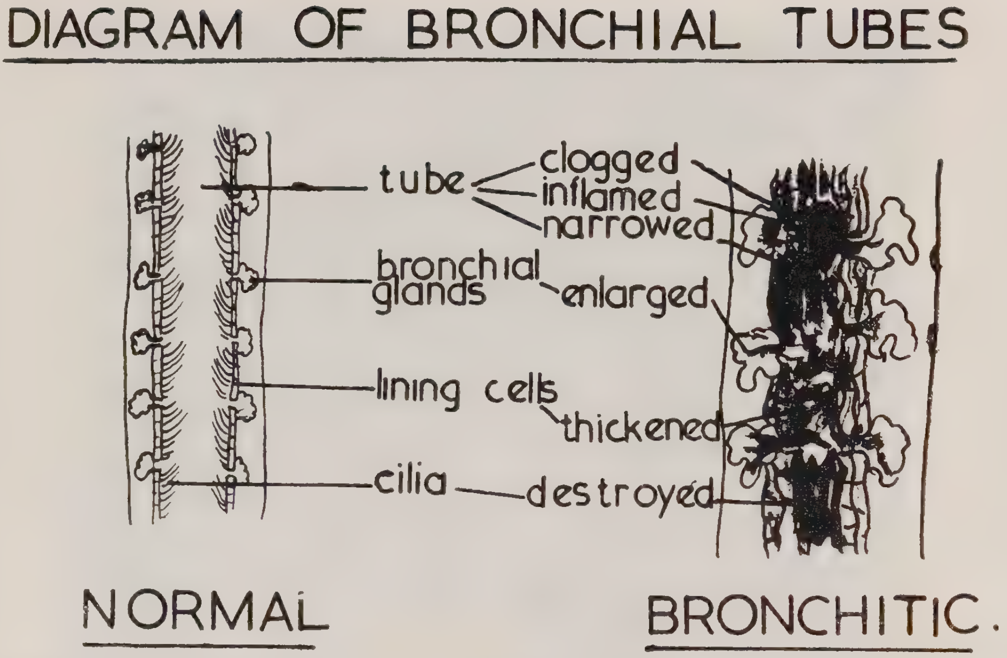

Figure 2. Diagram of bronchial tubes in normal and bronchitic persons

from there it is pumped to the brain and to the muscles and all parts of the body. The lungs and heart are so closely associated with each other that disease of one of them often leads to disease of the other. If the lung tissues becomes damaged or destroyed by inhaled irritant gases or particles, greater resistance will be met by the blood and the heart will have to pump harder to overcome this resistance. In some cases, the heart fails to do this and the person has a lung disease complicated by heart failure, which leads, sooner or later, to death.

Bronchitis

When the bronchial tubes become inflamed, the person suffers from bronchitis. Figure 2 is a diagram of the normal and of the bronchitic's bronchial tubes. In bronchitis, the tubes become reddened and the lining cells are thickened, the bronchial glands become distorted and secrete thick, infected pus instead of the clear lubricant in the normal tube. The lumen of the tube becomes narrowed so that the air no longer flows easily up and down but is obstructed in its passage and produces the well-known wheeze of the bronchitic and makes him breathless on exertion.

The natural reaction to the entry of irritants into the bronchial tubes is cough. This is a forceful increase in pressure, to try to dislodge the foreign particle. If cough is repeated frequently and daily (as it is in smokers and many town dwellers) it leads to disruption of the delicate air sacs of the lung. Figures 3 and 4 show the appearance of normal lung tissue seen under the microscope and of lung tissue which has been disrupted and destroyed by frequent coughing. Figures 5 and 6 show soot particles actually within the membranes of the lung tissue itself and beyond the force of a cough. Figure 6 shows how the walls of the air sacs have been thickened by irritation from inhaled pollutants so that there is an increased barrier for the oxygen to pass through. This man was breathless and in heart failure because his blood could not get enough oxygen.

Figure 7 shows how much greater is the number of deaths from bronchitis in this country than anywhere else in the world. The incidence of the disease in industrial towns in England is twice that of rural areas and in the Scottish Health Committees report on Bronchitis (1963) it is concluded that "the evidence incriminating atmospheric pollution is compelling and there can be no doubt that the freeing of the air

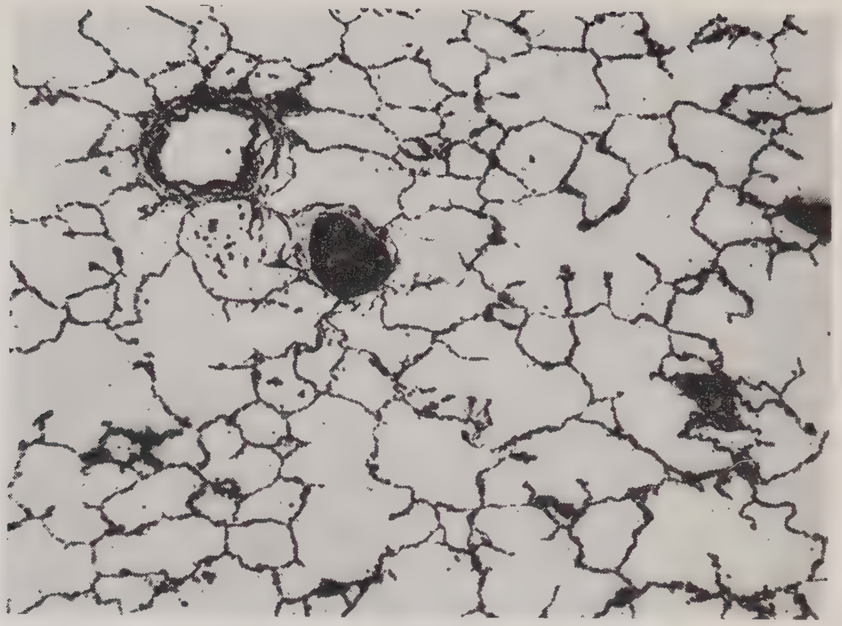

Figure 3. Microscopical appearance of lung tissue showing normal cobweb appearance of air sacs with gossamer fine walls

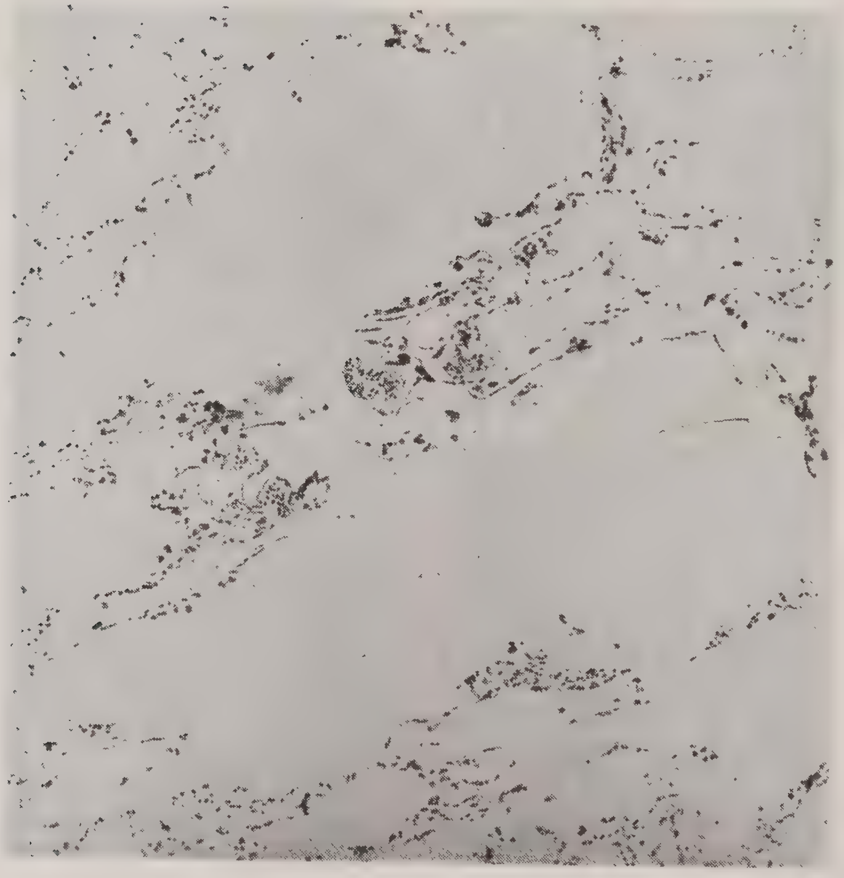

Figure 4. Microscopical appearance of lung tissue showing much destruction of the walls of the air sacs. Patient had had chronic cough for 20 years

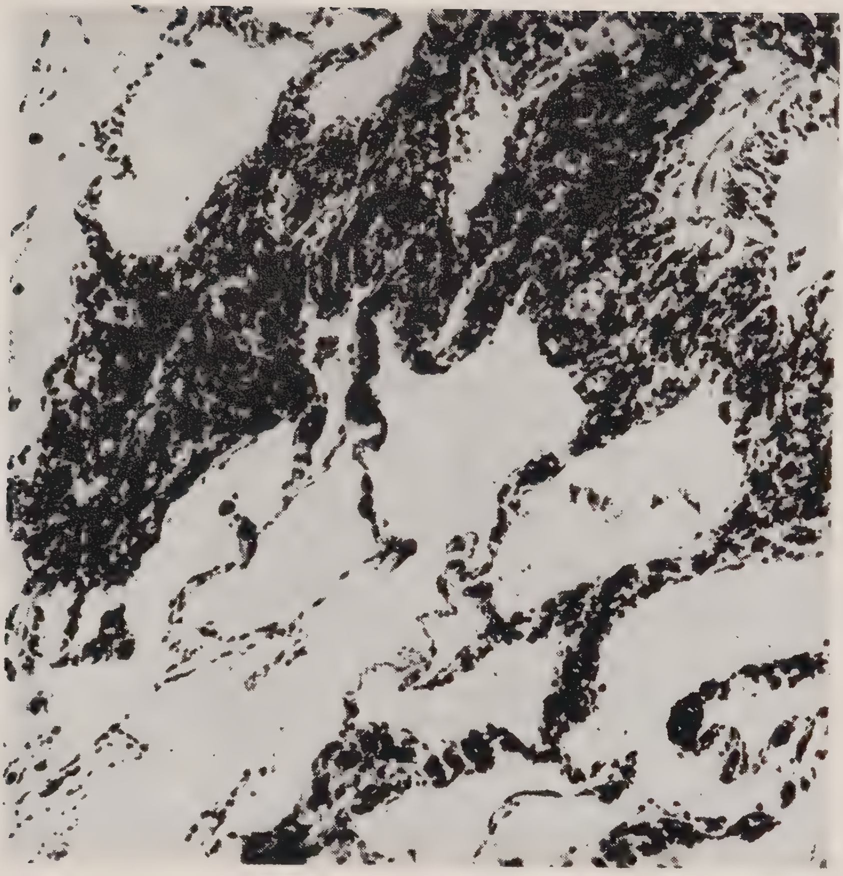

Figure 5. Microscopical appearance of lung tissue showing heavy accumulation of soot particles, with destruction of normal architecture of lung

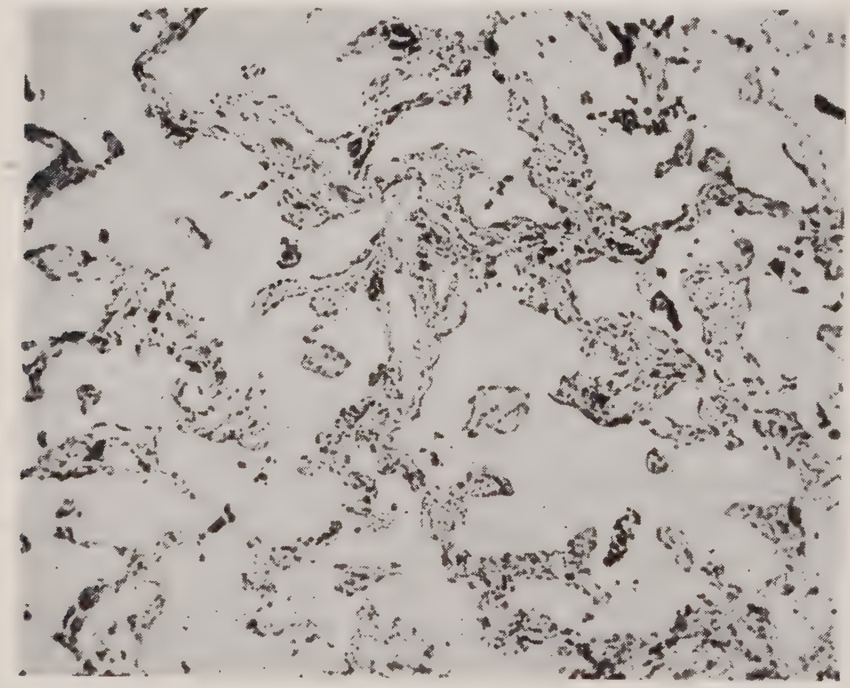

Figure 6. Microscopical appearance of lung tissue, showing air sac walls thickened by irritation of inhaled particles. Patient was unable to get adequate oxygen through these walls into the bloodstream

Bronchitis Death Rates among Men aged 35 years and over in selected countries, 1958.

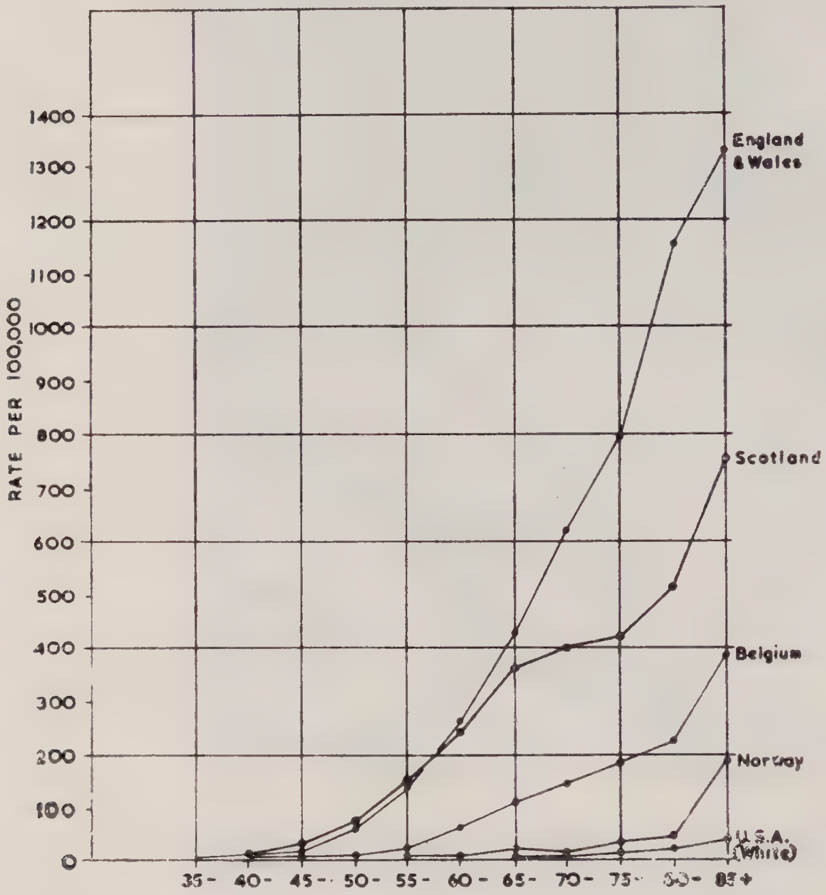

Figure 7. Showing greatly increased numbers of deaths from bronchitis in England and Scotland. (From Bronchitis-Report of Scottish Health Services Council, H.M.S.O.)

THE PROGRESS OF RESPIRATORY CRIPPLING

1. Cough.
↓
2. Breathless on walking uphills or upstairs.
↓
3. Wheezing, cough and breathlessness on cold foggy mornings.
↓
4. Lateness for work.
↓
5. Repeated absences from work through coughs and colds.
↓
6. Dismissal from work.
↓
7. Idleness at home.
↓
8. Progressive destruction of lungs.
↓
9. Heart failure.
↓
10. Death.

Figure 8

of the products of combustion, both visible and invisible, is likely to play a significant part in reducing the prevalence of this disease. This programme should be pursued with the greatest energy."

27,000,000 working days are lost each year through bronchitis and it has been estimated that 10–15 per cent of the population of industrial towns are crippled by respiratory disease. Figure 8 sets out the sequence of events which go to produce a respiratory cripple; these are often men in their 40's and 50's and at the height of their working skills and experience. The wastage of their skills through breathlessness is incalculable.

Lung Cancer

Cancer in many sites of the body is caused by repeated small doses of carcinogenic agents, which cause damage which is followed by repair, then further damage occurs and is followed by more repair. Finally this activity gets out of control and proliferation of malignant cells appears as a cancer. Cancer of the lung may follow this pattern from the repeated assaults on the lung tissue by smoky atmosphere and cigarette smoke. Smoke from improperly combusted coal contains a known carcinogen, benzpyrene and there are probably others. A strong correlation between increasing amounts of smoke and rising numbers

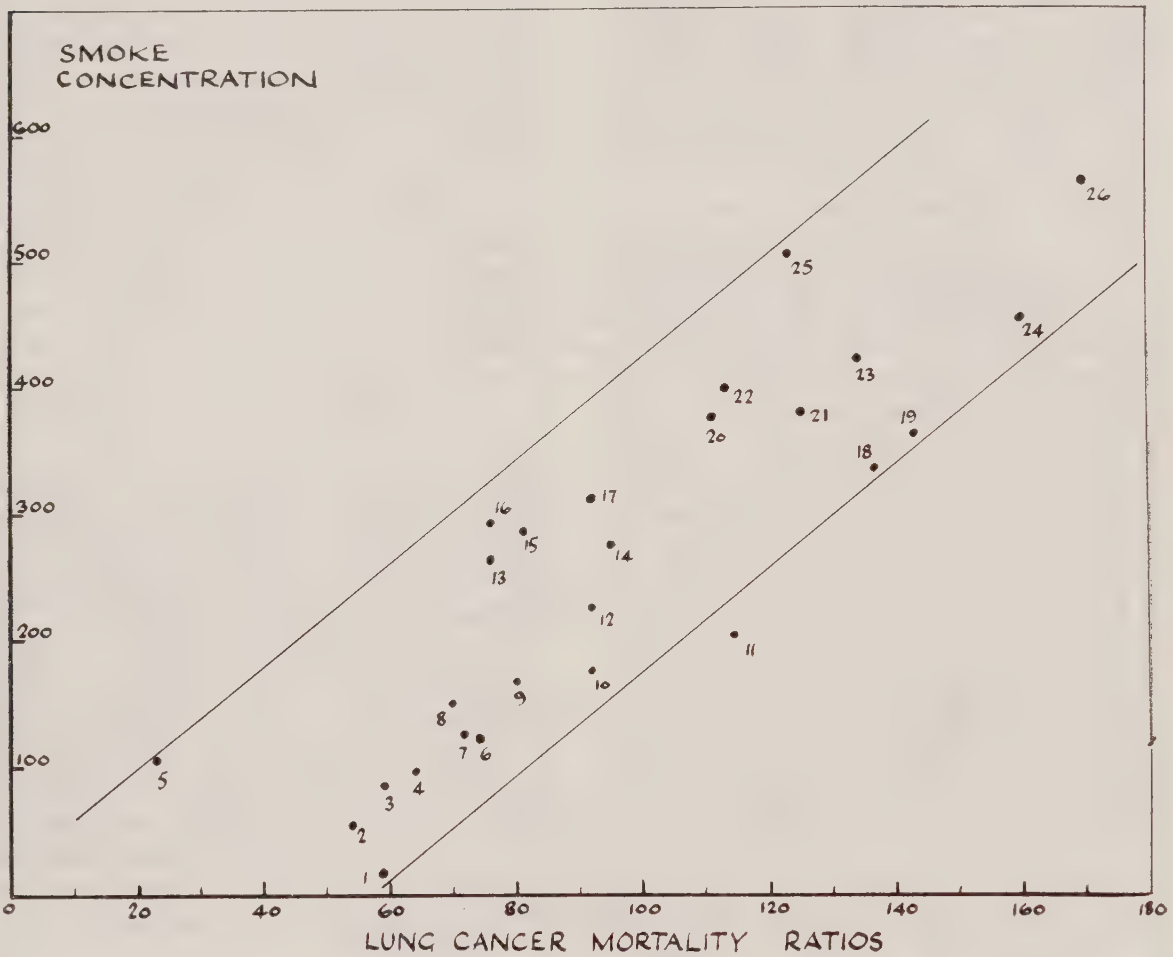

Figure 9. The correlation between increasing smoke concentrations (in mgm. per 1,000 c. metres) and lung cancer mortality ratios (from "Smokeless Air", Autumn, 1961). The numbers against the points on the diagram relate to the localities according to the following key:

1.—*Conway Valley*. 2.—*Llangefni*. 3.—*Tattenhall (Tarvin R.D.)*. 4.—*Wetherby*. 5.—*Ruthin*. 6.—*Blaenau Ffestiniog*. 7.—*Ripon*. 8.—*Elland*. 9.—*Flint*. 10.—*York*. 11.—*Chester*. 12.—*Ormskirk*. 13.—*Wrexham*. 14.—*Lancaster*. 15.—*Darwen*. 16.—*Keighley* 17.—*Burnley*. 18.—*Birkenhead*. 19.—*Bootle*. 20.—*St. Helens*. 21.—*Warrington*. 22.—*Gateshead*. 23.—*Leeds*. 24.—*Liverpool*. 25.—*Newcastle-upon-Tyne*. 26.—*Salford* of deaths from lung cancer has been noted by Stocks (1960) and this is illustrated in Figure 9.

The soaring increase in lung cancer is seen in Figure 10. While a large part of this is probably related to cigarette smoking, the unavoidable breathing of highly polluted atmospheres for 24 hours of every day must make a considerable contribution. Lawther (1963) concluded that "It may well be that a combination of cigarette smoking and air pollution is especially dangerous to us in Britain". From Figure 10, it will be seen that deaths from cancer in other sites of the body are being reduced, due to earlier diagnosis and better treatment and this makes the contrast with lung cancer even graver. Bronchitis deaths are seen to remain virtually unaltered in spite of antibiotics and chemotherapy. These drugs have had a marked effect on lung tuberculosis, deaths from which have fallen sharply.

Psychological Effects

The psychological effect of air pollution is impossible to measure in units acceptable to statisticians. The nearest one can get is the spontaneous revulsion of the countryman to an industrial town—the words "I couldn't live here", "Everything's so dirty", "Is Leeds Town Hall made of coal?" and the figures which show that young people of the industrial north are purposefully going to find work in the cleaner, brighter surroundings of the south.

For more concrete figures, the costs of cleaning one building in an industrial town are revealing. The General Infirmary at Leeds has approximately 900 beds and is in the centre of a city which was one of the most important in the industrial revolution and which is now the site of many different prosperous industries. In 1960 £84,000 was spent on trying to keep clean its inside

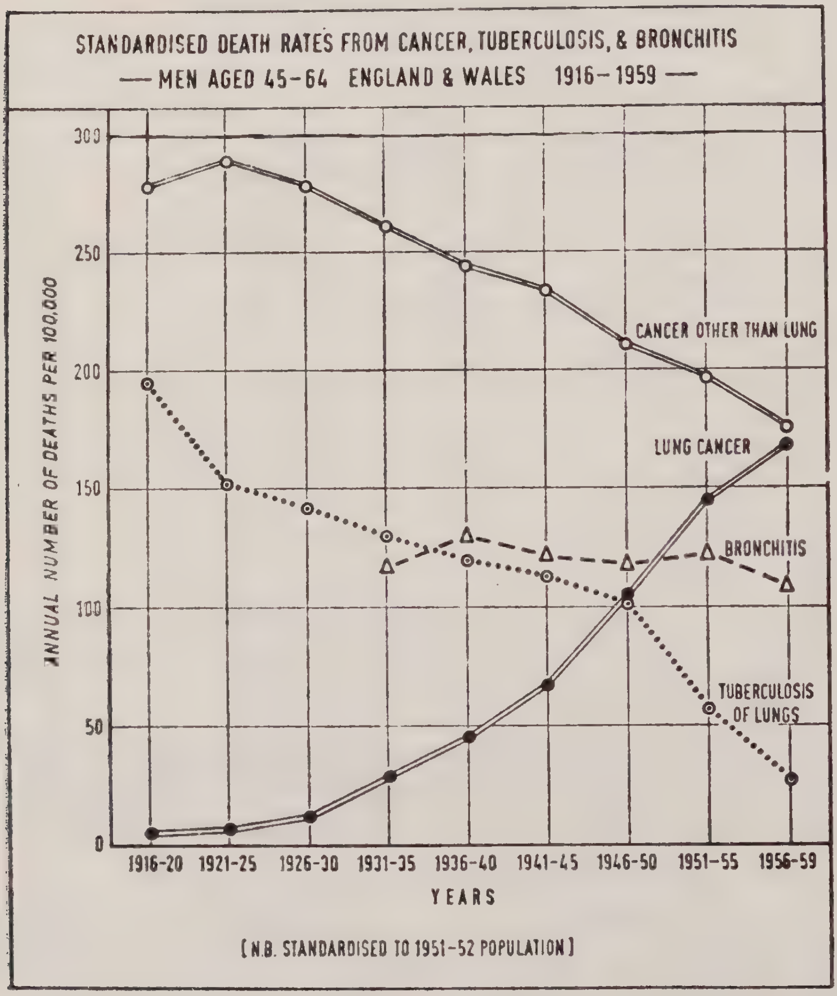

Figure 10. Showing marked increase in death rates from lung cancer, while deaths from cancer in other sites decline. The death rates from bronchitis remain virtually unchanged in spite of antibiotics and chemotherapy. Reprinted from R.C.P. report Smoking and Health

walls, floors and windows and this amount exceeded that spent on drugs by £4,000.

When these figures are related to the hours of drudgery which are the lot of the housewife in an industrial town, they assume a psychological importance. Spring cleaning can be stimulating and rewarding if it is done once a year in the Spring, but if it is done once a week because smoke, soot and grit pour into the house, on to paintwork, curtains and loose covers and children come home stained with black grease because they have climbed a tree—then the dirt of air pollution takes on the menacing role of a destroyer of morale. But the people are tough who survived the industrial revolution and the 200 years since, and they meet the daily grime with a stoicism so determined that it turns despair into complacent acceptance, in the phrase, "Where tha's muck, tha's brass."

One of the more measurable psychological effects of the dirt of air pollution is that money buys distance. As soon as the majority of people, who work in an industrial town, acquire enough money they use it to buy a house on the outskirts of the town, or in the country, and fast cars to transport them quickly to and from their place of business. Their wives are then relieved of the worst of the deluge of dirt and their children have a better chance of breathing clean air. But this leads to a progressive run-down of the centres of the industrial towns and an increasing neglect of the squalor caused by the factories and the old dwellings which were built round them.

Until people can be made to realize that industry does not necessarily have to leave squalid scars of soot and slag heaps, the industrial towns, on which so much of our economy depends, will remain places to avoid or places to leave as quickly as possible.

Pittsburgh, in the United States of America, which used to be one of the dirtiest cities in the world, is now a city of white skyscrapers and clear skies. Conferences are held there and great wide roads lead proudly to its centre. It produces vast quantities of steel and it boasts great medical centres, the largest open-air auditorium in the world, concert halls, important art museums, huge hotels and clean air. It is an industrial city which has undergone a second revolution—that of the scientific, technological approach to making goods efficiently and cleanly and giving the citizens a pride in their city. Instead of repelling young, scientific, artistic and contributory people, Pittsburgh attracts them.

If the industrialists of England would now precipitate a scientific revolution in their factories, a great impetus could be given to the work of cleaning the atmosphere of smoke from both factory and domestic chimneys. Greater efficiency of production would result, and healthier, happier people would be stimulated to invent new ways of clearing away the old wrecks of the first industrial revolution.

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Discussion

Dr. J. Greenwood Wilson (Port and City of London), opened the discussion by referring to his pleasure in speaking from a platform where Dr. Patrick Lawther was in the Chair and his appreciation of the two papers by Drs. Mary Catterall and J. S. G. Burnett.

He warned his hearers that he would have to make a confession to them which in its effect might have repercussions, at least before that audience, as great as those of the Profumo case! The fact was that despite having spent his early years in the Public Health Service in the industrial areas of Lancashire and Yorkshire, despite his admiration for those early pioneers of smoke abatement in the West Riding of Yorkshire, and despite his observation in Lancashire of men with legs which when put together looked like the letter O, he had never somehow gone on to become an enthusiast for the clean air movement.

Although he had felt like Paris the shepherd in A. P. Herbert's libretto to the delightful operetta "Helen" recently revived at Sadler's Wells, "that there must be something more", he had never been convinced wholly as to the medical evidence that atmospheric pollution alone caused all the medical complaints attributed to it. Thus with regard to the letter O legs, these were eradicated not by the clean air movement nor even by ultra violet light therapy, but by mass medication in the same sort of way as mass medication was now in process of eradicating tuberculosis throughout the world.

With regard to Dr. Mary Catterall's able paper—although it did wring his withers—he was not convinced as to the complete criminality of air pollution without some other factors operating as well. When he himself lived and reared a family in the heart of the industrial areas of Lancashire and Yorkshire, such unhappiness as he had, according to his recollection, could not be attributed to atmospheric pollution, which indeed was so intense that it was a problem to keep the window curtains clean of large smuts that came in whenever the windows were open.

When he left the industrial north, the speaker served for 21 years in Cardiff where, because they burned the Welsh steam coal, there was no smoke problem, so once again although his authority had subscribed generously to the funds of the Society, there had not been a great deal of enthusiasm for its aims and objects.

When however he had moved to the service of the City of London Corporation, he had come under the whips and scorpions of the Society's Hon. Treasurer, that great enthusiast in the clean air movement, Mr. Stanley E. Cohen, who had been urging him and other Officers on from the removal of visible smoke to the eradication of invisible air contaminants like sulphur. It was in the City that he had come under the sane influence of Dr. Patrick Lawther, their Chairman that day, whom he remembered saying once that he would meet Mr. Cohen and himself "at your convenience". Mr. Cohen and he then proceeded to meet Dr. Lawther in a W.C. in Fleet Street, where he had set up apparatus for measuring fumes from traffic at peak hours in the City and in anticipation of a recurrence of heavy fog.

As Dr. Burnett's paper* was largely factual he had little comment to make on it, except to say again that he was not convinced that diesel fumes, apart from being an unpleasant nuisance, were a danger to health. He recalled the work undertaken by the London Transport Passenger Board through their Chief Medical Officer, Dr. L. G. Norman, which showed no higher incidence of lung cancer or bronchial disease generally in bus crews exposed daily to diesel fumes in the garages where their buses were warmed up before starting the day's work.

I. Jones (Individual Member) made an appeal for the redoubling of their efforts to achieve clean air. He spoke as a chronic bronchitic and described vividly the deterioration in his physical condition following his removal from East Yorkshire to the West Riding. He deplored the facts, given by Dr. Mary Catterall, about expenditure on hospital building maintenance being greater than the annual outlay on drugs and medicines in Leeds.

He described the plight of the family of a bronchitic and made a plea to the conference regarding the need to remember the effects of air pollution on the frail and the chronically sick.

Dr. W. R. Martine (British Medical Association and Society of Medical Officers of Health) congratulated Dr. Catterall on having provided such an outstanding contribution to the case for clean air. That case need rest solely on health and members of the medical profession, especially general practitioners —the "family doctors"—were greatly concerned at the slowness of implementation of the Clean Air Act. Though much had been done, not least in Birmingham, whose Health Committee he had served for 26 years, it was not enough.

Local authorities were failing because they did not see a vigorous clean air policy as a worthwhile long-term investment, but rather as a luxury to which they must accord only low priority in the annual budget. They wanted an immediate dividend.

It was not always the Health Committee which was at fault, though some were undoubtedly to blame. More frequently

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**General discussion on this on page 52* it was those whose duty it was to fix the rates, with their ruthless cuts in the annual estimates and the shelving of such health projects as Clean Air in the face of others which showed more immediate results but were much less vital.

Much more could be said but he would content himself by appealing to all local authority representatives to go back from this conference determined to press and keep on pressing in Council, in Committee and outside for a more realistic approach in the light of the facts given them by Dr. Catterall.

Dr. E. C. Halliday (South Africa) described the cloudless conditions and low humidities that caused smoke concentrations to rise rapidly during the night in South Africa. He said concentration values were reached which were comparable with those of many towns in England. It was during these night periods that bronchial irritation was easily noticed, especially in the case of children. To stop the irritation it was necessary to close windows to exclude the smoky air. Because of the low humidity bronchitis was rare and so he knew of its effects only by hearsay. Dr. Catterall had given him a vivid mental picture of the human tragedy of this disease. In addressing meetings in South Africa he had usually spoken of air pollution as an irritant, but not as a killer. He now had an understanding of how it could be a killer in certain circumstances.

Dr. Halliday went on to suggest one line of thought to industrialists which might affect their actions. Air pollution by its irritating action, must of necessity increase the time taken by any person suffering from a respiratory disease, to recover and return to work. This meant that the loss of man-hours in industry, due to air pollution, was probably very considerable, quite apart from those lost by men being permanently incapacitated. Thus a reduction in air pollution should increase the industrial output of England.

Dr. W. C. Turner (Poplar) said that the effects of air pollution were still not clearly worked out and there was a need to continually assess the effect of everything put into the air, not only SO_2 but also CO_2—which is the principal end product of the burning of carbonaceous fuels. Now that large power stations were burning up to 20,000 tons of coal a day, the output of CO_2, a heavy gas, was enormous and during periods of low level inversion, unless the chimneys were high enough to penetrate the inversion and with sufficient thermal lift to prevent mixing, CO_2 concentrations at ground level could build up to 4 per cent and over, which was of definite physiological significance.

There was obviously a need to consider the effect of natural pollutants, to which they were exposed from the very moment of entry into their environment. What were these pollutants? Were they more prevalent in this country? Bronchitis was called the "English" disease—was there any reason for that? Dr. Turner suggested that the prime factor was the high natural humidity in this country, and he pointed out that Manchester and the Midlands became the centre of the cotton industry because the air was moist enough to prevent cotton fibres from breaking during weaving. The importance of moisture was that it was an essential environmental factor in the growth of fungi, the spores of some of which are always present in the air we breathe. These fungi, many of a particle size below five microns, could penetrate into the alveoli deep in the lung. The very nature of these minute protein particles suggested their probable importance as allergens. The fact that they could penetrate into the alveoli made this the target area. The association between similar but larger particles, *i.e.* pollen grains and hay fever was accepted. In this case the target area was the nose where the pollens were trapped.

Dr. Turner suggested that probably the principal initiating cause of bronchitis was mould allergy—not all persons exposed were sensitive, but those who do respond have superimposed on the primary condition the traumatic influence of repeated infection and man-made pollution.

Many Medical Officers of Health receive medical certificates in support of rehousing, two thirds of which link a triad of conditions. Respiratory catarrhs (bronchitis), dampness and overcrowding —the common factor in the first two being mould infection of the building, overcrowding making matters worse by raising the room humidity above 80 per cent which permitted the mould to grow and to accumulate moisture in its habitat.

The member from Hull, in a vivid description of the development of his incapacity from respiratory ill-health had shown clearly that his condition developed in a seaside town and that his condition was made immeasurably worse on removal to a grossly populated industrial area.

As an example of the adverse effect of smoke particles, particularly during smog, Dr. Turner told of the results of an experiment in a hospital ward during a recent smog. The air was cleansed of all particulate matter down to less than one micron in size by an electrostatic precipitator. The ward was completely clear of fog, no residual grime was left on the windows, and patients known to have bad chests were comfortable, at ease, and in no way affected by the fog, in sharp contrast to similar patients in other wards. The level of sulphur oxides inside and outside the ward were the same; a significant observation under the experimental conditions was that smog levels of sulphur oxide, in the absence of particulate matter, appeared to have no adverse effect on the patients. In the light of this observation it was clear that they must press on to secure as far as was practicable, the rapid elimination of all smoke and to re-assess the significance of sulphur oxide, and the effect on health, in the concentrations usually found in the air.

Dr. J. A. Bonnell (Central Electricity Generating Board) said he would like to remind Dr. Catterall that air pollution occurred in the South of England as well as the industrial North. Also that the main source of air pollution was the domestic chimney and not industrial chimneys; in fact industry was playing its part as was shown by the increased use of electricity as a source of industrial power. Large numbers of organizations were converting from coal and oil-fired boilers to electricity. The Society, he said, could play a part along the lines of Dr. Lawther's introductory remarks by drawing public attention to the time spent in obtaining consent for new power stations at public inquiries. These large efficient new power stations would produce a completely clean source of power by burning large quantities of coal centrally with provision for discharging the effluent gases through tall chimneys and thus reducing the air pollution at ground level.

J. T. Hesketh (Wrexham) referred to the difficulty in projecting the effect of smoke on the human body to the general public particularly in areas where miners received concessionary coal.

He said Dr. Turner's paper concerning the activities of the National Coal Board, was rather disappointing. After eight years of research they were told that they could produce 1,000 tons of smokeless fuel, if they were to be dependent on smokeless fuels for clean air then the country needs 400,000 tons per week. He did not think that smokeless fuel was the solution to clean air; the research people of the National Coal Board should look to an appliance to burn coal smokelessly, which was possibly a closed appliance automatically fed. It was being done in the industrial side. Britain was exporting smokeless fuels such as anthracite—838,000 tons for the first eight months of this year also 1,416,507 tons of manufactured fuel, gas coke, hard coke and breeze. If appliances existed to burn this fuel this would help the position considerably.

Author's Reply

Dr. Mary Catterall, replying to the discussion, said that Dr. Martine had pin-pointed one of the most important reasons for the slow progress being made in cleaning the air, when he said that local authorities regarded clean air as a luxury to which they must accord only low priority in the annual budget. This lack of conviction about the dangers of air pollution was also expressed by Dr. Greenwood Wilson. There was, however, a very considerable volume of literature now on the correlation between atmospheric pollution and respiratory disease and it was to be hoped that the substance of these papers, most of which appeared only in scientific journals, would be communicated to the lay public more widely and more effectively. The presentation of medical and scientific facts in an acceptable way was necessary, not only for those in authority on various councils, but also for those people to whom the open coal fire was a well-loved tradition which was fiercely defended. She thought that descriptions of personal handicap and suffering, such as were told by Mr. Jones, do a great deal to illustrate the need for cleaning the air by explaining what some people suffer from being forced to work in industrial towns and polluted air. Dr. Catterall had a great deal of sympathy for people who were told, without explanation, that their open coal fire must go and a smokeless appliance (which may not be fitted efficiently) be used instead.

Dr. Halliday had made an excellent point concerning the economic results from absenteeism due to respiratory disease, which must result in industrialists suffering considerable reduction in output.

As electricity and gas were the only fuels at present which were quite clean at the places of their use, it was clearly essential that supplies of these be increased as quickly as possible. Dr. Bonnell had pointed out that some of the delay in building new power stations for supplying electricity was due to the time taken in obtaining consent at public inquiries. It would also seem that the actual building of these important places could be much faster and perhaps more attention and research should be paid to improve the safety of power stations, not only by increasing the height of chimneys but by other methods of cleaning the effluent.

POLLUTION FROM ROAD VEHICLES

Report from the Society's Technical Committee

Presented by the Chairman, Dr. J. S. G. Burnett

THE Conference at Brighton in 1961 received a statement from the Committee on its views and proposals for the abatement of visible smoke from diesel engine vehicles which, prior to the conference, had been submitted to the Ministry of Transport.

In summary this memorandum concluded that the basic causes of smoke from diesel vehicles were failure to maintain the engine efficiently, overloading in relation to engine power, and excess of fuel feed. It was considered that possible devices for dealing with the smoke after it had been formed could not be of more than secondary value to measures for promoting correct combustion and engine usage.

The present method of control by the police, under the Road Traffic Act, was stated to be of limited effectiveness and "clearly is designed to deal only with excessive emissions for which a conviction can be reasonably expected".

It was concluded that "potentially the most effective, equitable and constructive form of control would be the extension, and wider application, of the existing powers of the Ministry's Vehicle Examiners to prohibit the use of offending vehicles until they have been put in good order"; that the visual judgment of the Examiners would suffice to determine that such action was needed; and that either the maximum load for any size of engine should be prescribed or that the fuel stop should be sealed at a point below that at which smoke formation begins to occur.

Members of the Committee discussed the memorandum with representatives of the Ministry of Transport at a subsequent meeting and it was gratifying to note, in reply to a question in the House of Commons, that the Parliamentary Secretary to the Ministry (Mr. J. A. Hay) had said:

"Following discussions with the National Society for Clean Air we are considering how we can improve observance of the law against harmful fumes" (February 14, 1962).

Following this, the Ministry's Examiners carried out a series of "spot checks" for black smoke emission during the summer of 1962. Mr. Ernest Marples, the Minister, stated in the House on November 7 that 83,000 diesel lorries were observed in three special nation-wide surveys. 9,800 were emitting black smoke, and of these 132 were taken out of service immediately and 3,900 were threatened with prohibition unless they later satisfied a second test. In addition, 4,000 warning letters were sent.

The Technical Committee has continued its study of the problem, and in a further memorandum to the Ministry (published in *Smokeless Air*, No. 124, Winter, 1962, p.98) it re-emphasized its conclusion that:

> "excessive smoke emission from diesel engines can be prevented if the metered quantity of fuel injected does not exceed that which can be burned completely in the engine concerned."

This is, of course, if the fuel pump, the fuel injectors and the engine itself are maintained in good order.

It was pointed out that the principle of limiting the amount of fuel to the amount that can be completely consumed was already recognized in the regulation that prevents the excess fuel starting device, which overrides the fuel stop, from being operated when the vehicle is moving. The memorandum added:

> "It is a logical step to require this control to be extended so that at all times the quantity of fuel injected is not in excess of the amount that can be completely burned."

It was suggested that it should be required, by Regulation, that the fuel stop be set by the manufacturers of the engine, before sale, at a point below that at which smoke can occur. The setting should then be fixed or sealed, and it should be an offence for any person other than one authorized by the Ministry, to remove the seal or to alter the setting.

A deputation from the Committee has recently had a further opportunity of meeting representatives of the Ministry, when this proposal was discussed in more detail, and the further suggestion was made that all diesel vehicles should be required to be inspected annually in respect of liability to smoke emission.

It was pointed out to us that the Ministry is currently represented on a British Standards Institute Committee set up to consider performance standards, including horsepower rating in relation to the smoke limit for diesel engines in road vehicles, and it was indicated that it might be possible to consider the Society's proposals in conjunction with any "use" regulations that may be made when the proposed new standards have been formulated.

The Committee has discussed the use of smoke meters, of the Hartridge or Bosch type for measuring the density of smoke emission, and the practice in Belgium in which the former instrument is used. Such measurement can be made on a vehicle at rest, or with the instrument set up on the vehicle (in the case of the Bosch meter), and it is felt that they would be of value when the facts of an alleged emission are disputed or if legal proceedings are involved. For the kind of control proposed by the Society, and used in the Ministry's spot checks, measuring instruments are not considered to be necessary, and were not used in these checks.

Other aspects of the road vehicle problem being considered by the Committee are exhaust fumes and gases from petrol-driven vehicles, where carbon monoxide is the principal danger; and the special case of diesel engined taxicabs, especially in the London area. The latter problem is not one of gross smoke emission from comparatively few vehicles, but of frequent short bursts of smoke, especially on accelerating, from a large number of vehicles, for the most part in congested city streets. The difficulty appears to be economic: for the lively performance expected of taxicabs the maximum power fuel setting is too close to the smoke formation point, while larger engines with more satisfactory clear exhaust settings, are said to be too expensive.

The Committee has taken note of the studies of other groups and organizations working on the problem, and would like to draw attention to the report of a Vehicle Exhaust Study Group of the Institute of Road Transport Engineers, which was recorded in full in *Smokeless Air*, No 126, Summer, 1963, p.304.

The present conclusions reached by the Committee to date can be summarized and stated in a form that, if approved by the Annual Conference, can be adopted as a resolution to be submitted to the Ministry of Transport.

The following resolution is therefore proposed:

> This Conference, having considered a report of the Technical Committee of the Society on air pollution from road vehicles, requests the Minister of Transport:
>
> (*i*) To introduce regulations under which the fuel stop on all new diesel engines for road vehicles shall be set and sealed at a point below that at which smoke formation may occur; and pro-

hibiting any alteration to the setting except by persons authorized by the Ministry.

(ii) That all diesel-engined vehicles be required to undergo an annual inspection with respect to liability to produce smoke, including the setting and sealing of the fuel stop as for a new engine.

(iii) That control checks of the type instituted by the Ministry in 1962 be continued* and extended on a national and permanent basis; and that to make this possible the number of Vehicle Examiners of the Ministry be increased as required.

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* The following Press Notice was issued by the Ministry of Transport on August 28, 1963, while this report was being printed:

Out of 25,000 diesel-engined lorries observed on the roads by Ministry of Transport technical staff in a country-wide check on June 12, 3,200 were emitting too much smoke. The check was made at 90 different points.

Of the 3,200 "smokers", 1,700 (about 7 per cent. of the total observed) were prohibited for the carriage of goods. In 83 cases, the prohibition notices took effect immediately; in the other cases, a few days grace was given in which to get the defects remedied. The remaining 1,500, which were not "smoking" so badly, were dealt with as necessary by warning letters being sent to the operators and by visits from the Department's inspectors.

Comparing these results with those obtained in last year's checks, the ratio of "smokers" to "non-smokers" observed on the roads was approximately the same —about 1 in 8; but this time a higher proportion of the "smokers" was made the subject of prohibition notices—7 per cent. against 5 per cent.

This is accounted for by a reduction in the number of "silent" checks, in which examiners do not stop vehicles on the road but merely note their numbers for later follow-up action.

Since the figures show no reduction in the number of smoking vehicles, the Ministry will continue these roadside checks, both nationally and regionally, as a means of bringing home to offending operators and drivers their responsibility for ensuring that their vehicles do not emit excessive smoke.

Discussion

H. C. Redburn (Road Haulage Association) stated that his Association endorsed the resolution being put forward by the Technical Committee. He represented an Association whose members operated some 100,000 diesel engined vehicles and they did not wish to cause offence to anyone as they were all potential customers. The members were proud of the good name of the heavy vehicle driver and concerned with the problem of the smoking vehicle. They felt that the vehicle operator was bearing a burden unfairly put on them by the vehicle maker.

He stated that members had always been encouraged to maintain their vehicles to a very high standard. They were their tools of trade, earning their bread and butter for them.

Since 1959 the Association, with every form of assistance it could stimulate, had tried to improve the position. In 1960 they had joined the Clean Air Society, and in the same year met Dr. P. J. Lawther, the Director of the Air Pollution Research Unit of the Medical Research Council, and the Chairman at that session of the conference. Mr. Redburn stated that an approach had also been made to the Society of Motor Manufacturers and Traders, the Road Research Laboratory of the Department of Scientific and Industrial Research, the Diesel Engine Research Association, the British Standards Institution and the Ministry of Transport. They had put forward their views to these interested organizations. In 1960 a representative of the Association had addressed the conference and in 1961 had met the Society's Technical Committee. As a result of all these labours there was now a Technical Committee AEU/2 set up by the British Standards Institution to prepare a performance standard for diesel engines, with particular reference to smoke emission. Mr. Redburn concluded by saying that it was hoped that when this Committee had produced a standard, manufacturers would make vehicles which could operate without annoyance to the general public, as well as to members of the Society.

H. D. Fawell (Ministry of Transport) said that his Minister and indeed all those at Ministry of Transport headquarters who were involved with the problem of smoke from diesel engined road vehicles were concerned to be rid of black smoke and any submission to the Minister by Conference would be received accordingly. In view of this submission he would not comment directly on the Report but would offer Conference some data and factual information which might be of interest to them when considering the Report.

The last national smoke check on September 18 had shown that approximately the same number of vehicles had passed the check points as at the earlier check in June but that the number of "smokers" had dropped from approximately 3,200 to 2,400. The latest figure represented approximately one in ten of the vehicles observed as compared with the earlier figure of approximately one in eight. This was encouraging but the reduction should not be regarded as being statistically significant or cause for undue optimism. During the four months—June to September—regional checks had resulted in the issue of approximately 1,700 prohibitions for smoke. This was roughly equivalent to the number of prohibitions issued during each of the national checks. The Department intended to continue both national and regional checks.

With regard to the remarks made by Dr. Burnett about the Belgian method for checking smoke and in particular his view that loss of use of the vehicle was more of a deterrent to the operator than a fine, Conference was told that the United Kingdom method as practised by the Department's Vehicle Examiners had an almost identical effect. The only significant difference was that where the Belgians used an instrument to assess smoke, Vehicle Examiners relied on their experience. Conference was also reminded of the Minister's statement about the setting up of a Plating Committee. It was visualized that vehicles would be required to carry a plate indicating their maximum permissible weight and that it would be an offence for this weight to be exceeded when the vehicle was in use, so providing a deterrent against overloading.

As to the remarks made about the activities of the British Standards Institution's Committee considering diesel engine performance the Conference was told that the Ministry of Transport, Warren Spring Laboratory and M.I.R.A. had been carrying out tests in order to try and establish co-relation between subjective assessments of smoke by observers and measurements by instruments. This information would be of value to the Committee when considering test bed measurements of smoke from new engines.

Turning to the proposed Resolutions Mr. Fawell made the following comments:

Sealing of pumps had been carried out by manufacturers of certain types of fuel pumps for the past 30 years. This was perhaps unfortunate because people determined to "fiddle" had had ample opportunity to perfect their technique. Past experience had shown that it was by no means impossible to tamper with a pump and reseal it. In this connection the Department had followed up some thousand cases of smoking vehicles in order to determine the cause. While it was difficult to obtain evidence of deliberate tampering the remedial measures necessary to eliminate smoke indicated that tampering was one of the least frequent causes. Many modern fuel pumps had no adjustable stop and there was therefore no need for sealing.

During the debate on the raising of the speed limit Ministers in both Houses gave an undertaking to investigate schemes for intensifying the Department's effort with regard to the checking of goods vehicles and this undertaking was being actively pursued. With regard to staff, there was to be further recruitment of additional Vehicle Examiners and the necessary steps were already in train to this end but it must be realized that the problem of recruitment was not just a financial one. There was difficulty in finding men of experience and discretion who were suitable to carry out the duties of Vehicle Examiners. As had already been said there was every intention of continuing smoke checks both nationally and regionally.

P. Yorke (The Public Transport Association) said his Association which was concerned only with buses, was wholeheartedly behind the spirit underlying the report presented by Dr. Burnett. Quite apart from what had been said already fuel pumps were a big thing in the bus industry. They just could not afford to have them working inefficiently, and nothing was more expensive than black smoke. All responsible operators, therefore, were prepared to spend large sums in capital equipment for maintenance purposes, and the Association liked to think its standards in this respect were very high.

With regard to the Resolution No. (ii), the Association was already subject to annual inspections by the Ministry. They were constantly overhauling their fuel pumps, often well inside the first 12 months of fitting, usually in their testing plants but sometimes on the vehicles. As it stood at present, the Resolution appeared to be unduly narrow, because it would clearly be a bad thing if their operators were prevented by red tape from altering a faulty setting of a fuel stop in the shortest possible time.

In any case, the words "by persons authorized by the Ministry" might be taken to exclude expert fitters employed by an operator.

S. V. Goodman (Bedfordshire) in a written contribution, raised the subject of fumes from diesel engines in partially enclosed railway stations and drew attention to the fumes which permeated the standing trains at St. Pancras Station, where engines were running for a lengthy period prior to train departures. The overheated carriages were filled with diesel fumes, which required many miles with open windows to clear.

Were these fumes caused by faulty combustion, and was it necessary for the engines to run in an enclosed space for long periods prior to departure of the train?

G. W. Dhenin (Bath) in a written contribution, noted the Chairman's remarks that no serious health hazard had yet been proved in connection with diesel smoke and that the Society was at a critical stage of development, when false or exaggerated claims of damage by various pollutants could harm the standing of the Society in the eyes of other interested bodies. While accepting this he would like to make the following points:

Smoke from diesel exhausts was unnecessary and a sign of faulty operation and/or maintenance of the engine. It was obviously bad and the resolution of the Technical Committee should be supported from every angle.

Smoke from road vehicles could also be a hazard to safety when drawn in through the heating systems usually found on modern cars, tending to cause drowsiness in the driver.

Again persistent smoke from a diesel vehicle could obscure the visibility from following vehicles, causing irritability to the driver and perhaps encouraging him to take unnecessary risks to pass at an unfavourable moment.

Experience on the road seemed to show that at least one diesel vehicle in ten, emitted excessive smoke.

S. Jones (Deputy Chief of Research, British Railways Board) in a written contribution replying to Mr. Goodman, said that the fumes referred to in the question almost certainly arose not from the engines but from railcar heater units which also burned oil and must be kept in operation to maintain a satisfactory temperature. Traces of those fumes might under certain conditions enter a car, particularly when the set was standing in an enclosed area, such as in bay platforms. Some modifications already made had reduced this nuisance but the British Railways Board were aware that some further developments might be required, and these were under investigation.

Industry and the Clean Air Act

(I) PROGRESS IN A HEAVY CHEMICAL INDUSTRY

by

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SUMMARY

The paper discusses the nature of the air pollution problems faced by a large chemical industry, particularly following the Clean Air Act. It outlines the steps that have been taken to solve these problems and describes problems still remaining and their possible solutions.

INTRODUCTION

THE Alkali Division of ICI, Ltd. is a major heavy chemical industry The principal products, that are manufactured in large tonnages (a total of about 6,500 tons/day), are sodium carbonate (soda ash), caustic soda, lime and salt. Manufacturing these products involves the burning of correspondingly large tonnages of fuel in boilers and process furnaces; at the time of the passing of the Clean Air Act, 1956, the Division (as it was then constituted) was burning about 1 million tons/year of coal. The products of the combustion of this fuel (Table 1) are discharged to atmosphere, much of it from a highly localized complex of works in mid-Cheshire. Reducing the consequent atmospheric pollution to an acceptable level has presented a variety of difficult problems.

The passing of the Clean Air Act did not demand any fundamental change in the Division's attitude toward the problems of reducing atmospheric pollution. Major industries are not usually unmindful of their social responsibilities, and steady and significant progress in reducing pollution had in fact been made before the Act was passed. For example, new and (in some cases) more efficient grit arresting plant had been installed, and chimneys erected post-war were considerably higher than pre-war construction. So far as Alkali Division was concerned, the effect of the Act was, broadly, to precipitate action by imposing specific immediate requirements.

This paper outlines:

the nature of the atmospheric pollution problems faced by a large chemical industry (particularly following the Clean Air Act);

the steps that have been taken to solve them;

the problems still remaining and possible solutions.

BOILER PLANTS

Table 1 shows that boiler plants, which raise steam for power generation and process use, consume about

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[*] Technical Department, Imperial Chemical Industries Ltd. (Alkali Division).

TABLE 1

Coal Burnt and the Level of Dust, SO_2 and Smoke Emission from the Works of the Alkali Division in 1956

	Tons/year	*Grit and Dust tons/year*	*SO_2 tons/year*	*Smoke Ringelmann No.*
Boilers	663,000	7,500	20,000	<2
Secheurs	128,000	400	3,000	2–4
Finishing Machines . .	91,000	350	3,000	2–>4
Caustic Pots	45,000	100	1,000	2–4
Lime Recovery	142,000	* 3,000	3,000	<2–>4
Sodium Silicate and Aluminate Plants	7,000	50	200	2–4
	1,076,000	11,400	30,200	—

* The installation of high efficiency cyclones had just been completed. The figure quoted had been reduced from approximately 9,000 tons/year.

half the total fuel used. And all boilers are liable to emit smoke, and the flue gases always contain grit and dust in various degrees.

Fortunately, the high pressure boilers (all of which have been installed in the last 30 years) were, from the start, provided with automatic combustion control systems. Thus, control of smoke emission has never depended on the skill and attention of human (and therefore fallible) operators. The original automatic control system provided used the well known "Air-Steam Ratio" principle, in which, for a given steam output, the combustion air flow and fuel feed rate were automatically regulated to give a predetermined "optimum" CO_2 content in the flue gases. Recently a new system has been devised in the Division[1]. In this system, variations in steam demand automatically regulate the quantity of combustion air, and the rate of fuel feed is automatically regulated to maintain a constant oxygen (that is, excess air) content in the flue gases. This system is being installed on all chain grate boilers and is expected to improve operating efficiency and hence reduce atmospheric pollution. A further refinement has been developed[2] to control automatically the proportion of secondary air (on which smoke production depends critically) injected directly into the furnaces. Thus, dark smoke is only emitted when there has been a plant failure (for example, secondary air fans) or during soot-blowing, both of which are permitted under the Act.

The quantities of grit and dust produced are:

chain grate boilers, about 0.01 tons/ton fuel;

pulverized fuel boilers, about 0.13 tons/ton fuel.

Some of the older chain grate boilers had no grit arresting plant at all, and some only had very primitive arresters. The problem of installing arresting plant was made very difficult by the confined and congested nature of the site both at the rear of the boilers in the boiler house and at the chimney bases (Figs. I and II). After considerable investigation culminating in a full-scale, long-term plant trial, a compact multi-cell arrester was found that would give a reasonably good (about 80 per cent) collecting efficiency, and which could be fitted into the boiler houses (Fig. III). These arresters are to be fitted to all those boilers now having no arresters. Further experimental work demonstrated that the primitive arresters

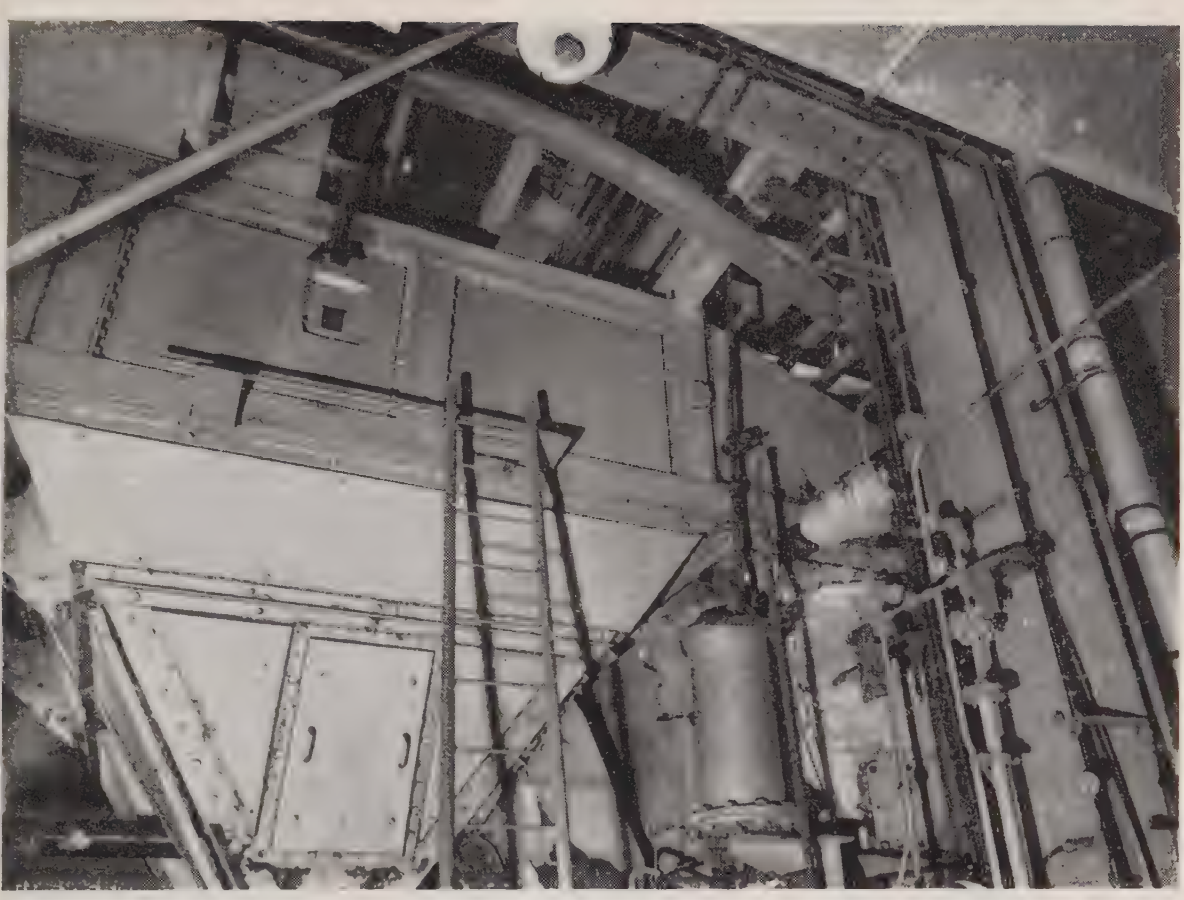


Figure I. Congested site at rear of H.P. boiler

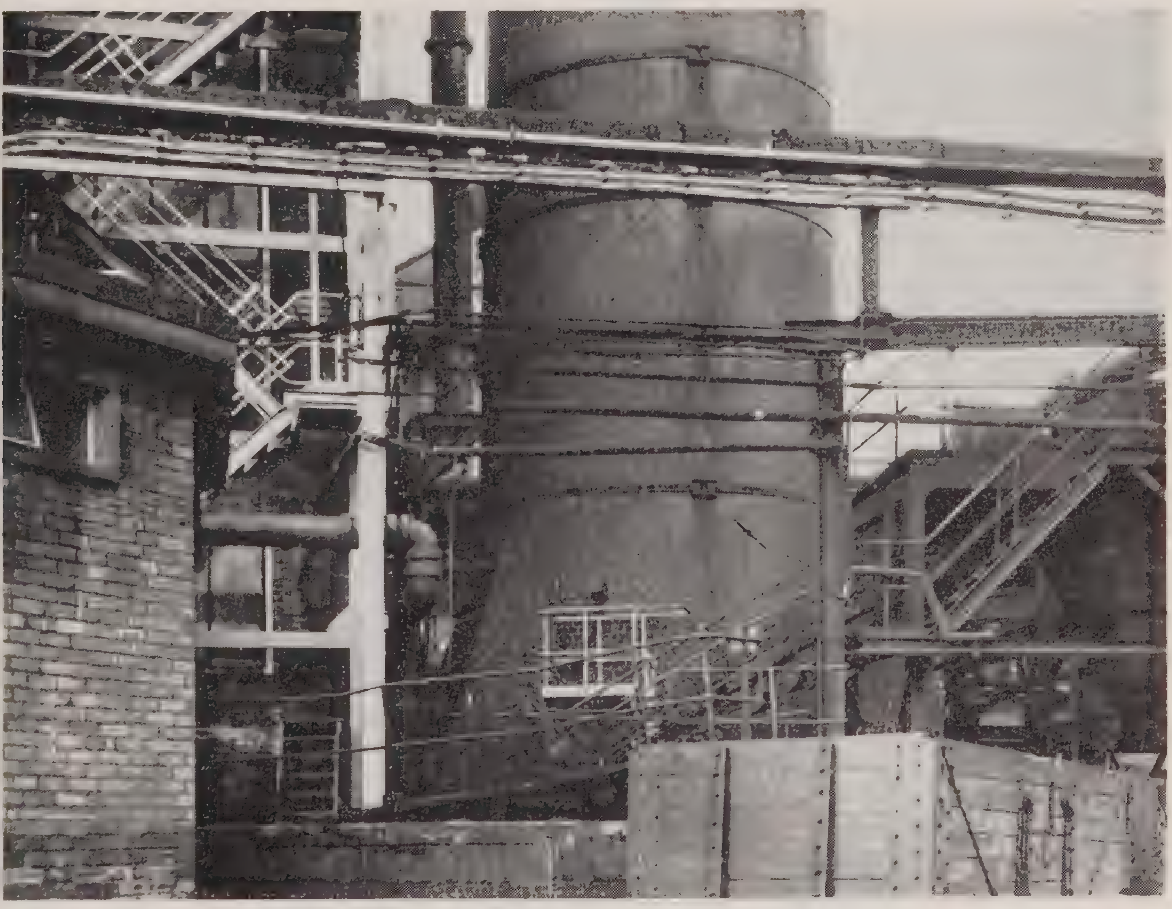


Figure II. Congested site around chimney base

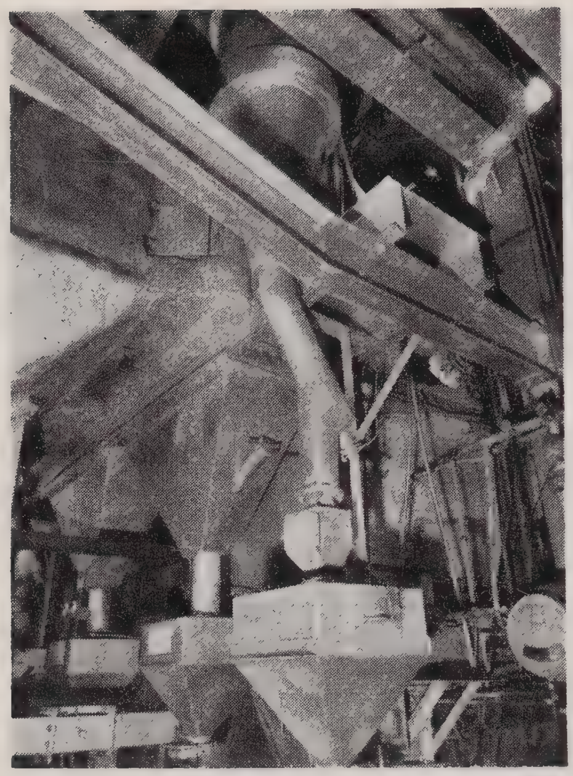


Figure III. Grit arrester fitted into congested site shown in Figure I

fitted to some of the boilers could be modified so as to improve their efficiency to an acceptable level. When all this plant has been installed, the Alkali Inspectorate has agreed that, within the meaning of the Act, the grit and dust emission from these chain grate boilers will be acceptable.

The only satisfactory way of collecting the large quantities of fine dust produced by pulverized fuel boilers is to use electrostatic precipitators. Three such boilers installed some 10 years ago were provided with multi-cell mechanical arresters; the collecting efficiency of these proved unacceptably low and not amenable to improvement, and they have been replaced with electrostatic precipitators. Two new boilers installed in the last few years were provided initially with precipitators.

Finishing Machines

One operation in the production of soda ash by the ammonia soda process is the conversion of crude sodium bicarbonate to sodium carbonate. This is done at some works in "finishing machines", sometimes known as Thelan pans. These (shown diagrammatically in Fig. IV) are long, narrow cast iron pans with internal agitators and heated externally by coal fires; crude bicarbonate is fed in at the fired end and finished sodium carbonate (soda ash) is discharged at the other. These machines burn graded fuel on coking stokers with induced draught only. In conjunction with a waste heat boiler they are highly efficient even though the process is historically archaic.

The nature of the apparatus (long and narrow) and the process (the finished product should not be discharged at less than 150°C) required long, "lazy", luminous flames. Consequently, the quantity of excess air had to be reduced to a minimum and the chimneys frequently emitted dark smoke. To comply with the Act, operating techniques were improved. For example, the complicated mechanism of the coking stokers was modified to give a finer control of fuel feed; better dampers were provided to facilitate the control of draught to

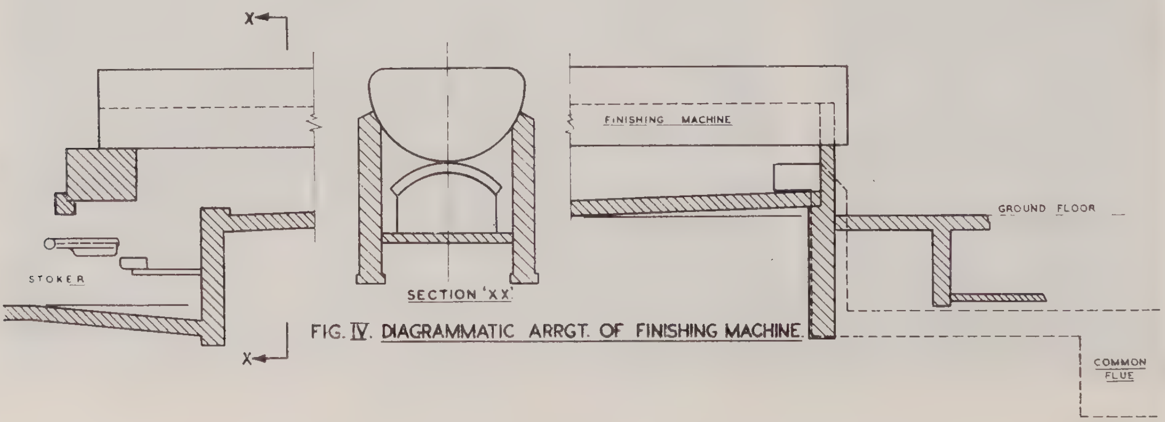
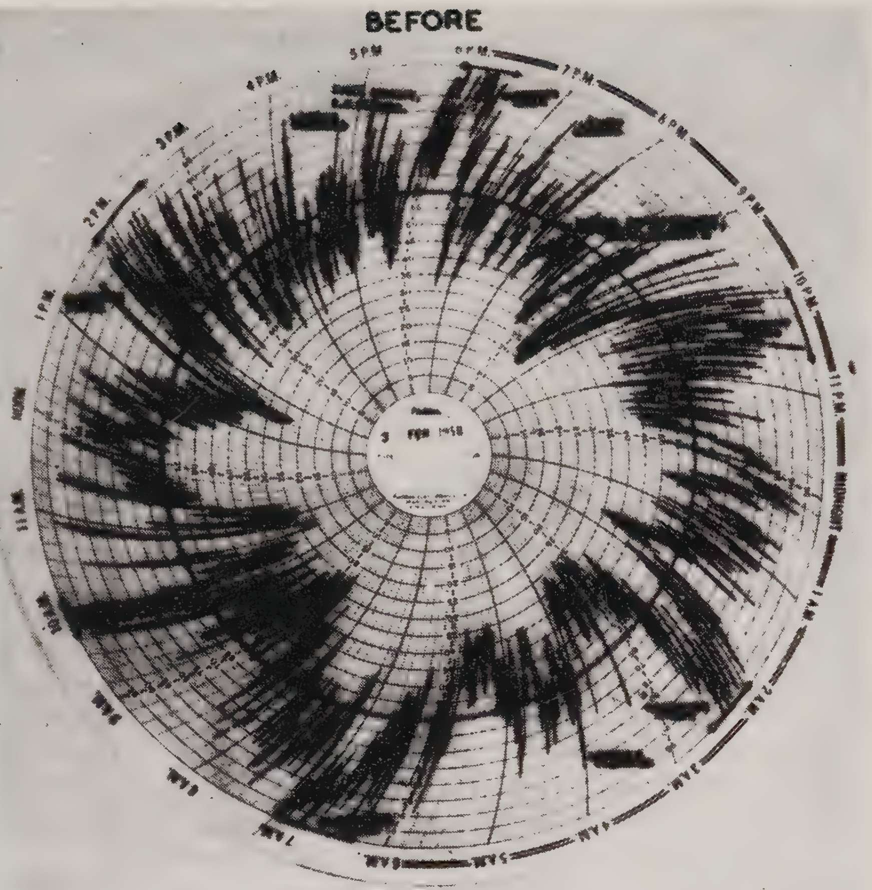


FIG. IV. DIAGRAMMATIC ARRGT. OF FINISHING MACHINE.



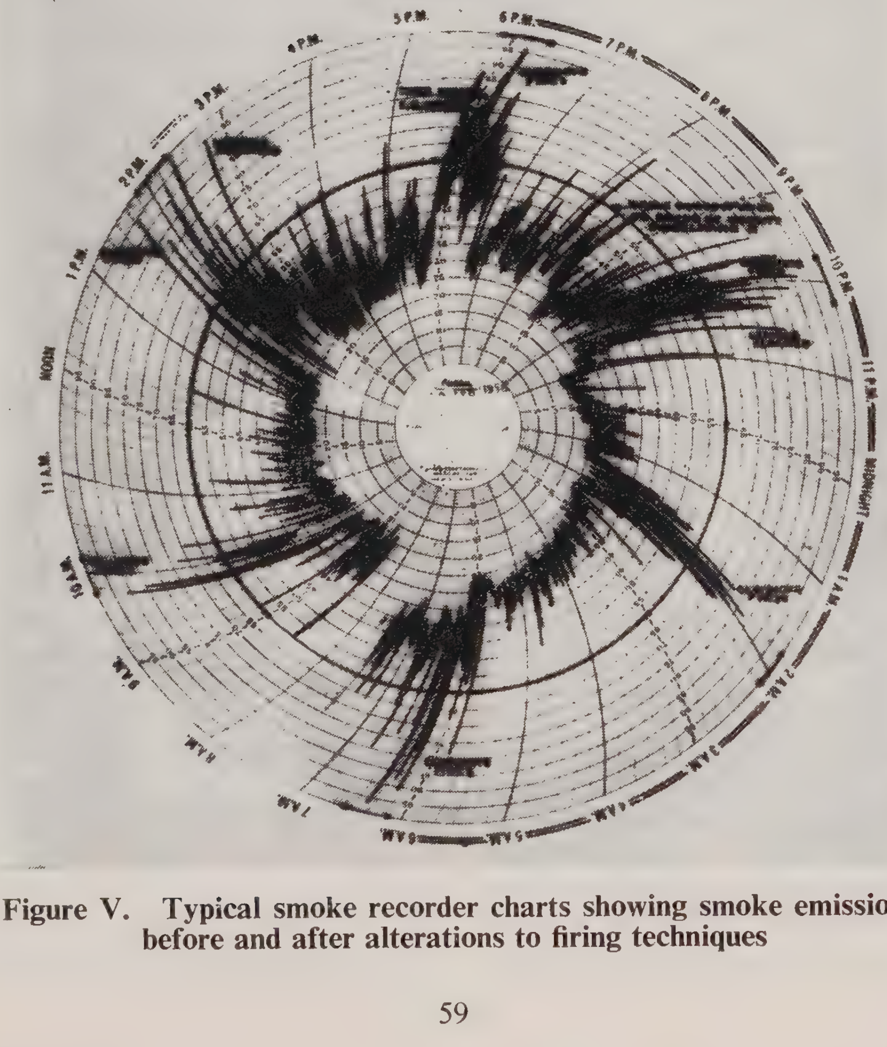


Figure V. Typical smoke recorder charts showing smoke emission before and after alterations to firing techniques

individual machines from the common flue. Nevertheless, smoke densities could only regularly be kept below the statutory Ringelmann No. 2 by increasing the proportion of excess air with the result that combustion efficiency was reduced by about 5 per cent; this increased fuel costs at one works by £5,000/year. The typical smoke recorder charts in Fig. V shows smoke emission before and after this action was taken.

Two economically acceptable alternative solutions have subsequently been employed. At one works the coal fired machines have been replaced by steam heated machines. In this case the coal is burnt in a central boilerhouse, where control of smoke emission is relatively easy, rather than in the finishing machines. At another works one machine was converted experimentally (and successfully) to oil firing; had not this works closed down half the machines would have been replaced by steam heated machines, and half probably converted to oil firing.

Fortunately, because they burned graded fuels and the gas velocities are low these machines presented no grit and dust emission problems.

Secheurs

At one works the finishing process described above is performed in plant called "secheurs", these are essentially the same as finishing machines except that the crude bicarbonate passes through a rotating drum heated by a coal fire on a chain grate stoker with both induced and forced draught. Here operating without emitting dark smoke was inherently easier (combustion is more easily controlled on a chain grate stoker with balanced draught than on coking stokers). Nevertheless, dark smoke was still sometimes produced because unsteady conditions in the chemical process demand frequent manual alterations to the combustion process. The problem was solved after extensive experimental work by devising and installing an automatic control system that enabled steady combustion conditions to be maintained. The plant is at present being converted to oil firing and this (oil being homogeneous and, therefore, easily controlled fuel) will further facilitate compliance with the Act.

Here again, graded fuels were burnt and gas velocities were relatively low so that grit and dust emission presented no problems.

Pot Batteries

In this plant caustic soda liquor is concentrated to anhydrous caustic soda in cascades of large cast iron pots heated externally by burning graded coal in coking stokers. Control of combustion was extremely difficult. Not only were the complicated stokers difficult to control, but the pot settings and flues were tortuous and vulnerable to air ingress and the draft was consequently poor. Dark smoke emission was therefore difficult to prevent.

Attempts were made to improve combustion control by modifying the stoker mechanisms to improve control of fuel feed, by fitting more easily operable dampers and by applying considerable effort in minimizing air ingress. Only partial sucess was achieved, however, and complete control of dark smoke emission has only been obtained by converting to oil firing and simplifying the run of the flues.

Again there was no grit and dust emission problems.

Rotary Kilns

These kilns, which are essentially the same as cement kilns, are part of a recovery cycle in the production of caustic soda by the lime-soda process. In them, calcium carbonate mud (precipitated when sodium carbonate and calcium hydroxide are mixed to produce a weak sodium hydroxide liquor) is calcined to calcium oxide ("burnt", or "active" lime) which is slaked to calcium hydroxide and reused. The kilns (Fig. VI) are fired internally with pulverized fuel.

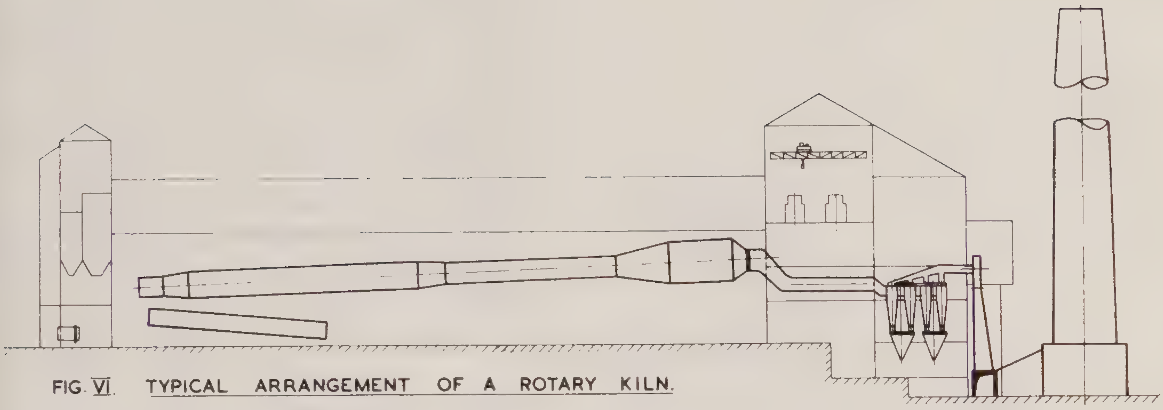


FIG. VI. TYPICAL ARRANGEMENT OF A ROTARY KILN.

Not only was control of combustion relatively primitive, but the pulverized fuel tended to hold-up in the bunkers and in the fuel feed system. The consequent "flushes" of fuel, resulted in dense black smoke being frequently emitted. After extensive experimental work a successful automatic combustion control system, based on the measurement of the oxygen content of the flue gases (that is, the excess air), was devised and installed. Furthermore, the original bin-and-feeder fuel system was replaced by a direct firing system to eliminate the tendency toward producing bursts of black smoke due to erratic discharge of pulverized fuel from the bunkers. Considerable improvement followed, but a complete solution was found by converting a kiln experimentally to oil firing; the whole plant is now being converted to oil firing.

At this plant, large quantities of grit and dust were also emitted, originating both from the pulverized fuel and from the burden in the kiln. The kilns always had been fitted with mechanical arresters but their performance was considered inadequate. Some years before the Clean Air Act became law, batteries of new high efficiency cyclones had been fitted to each kiln and the grit and dust and lime emission had been reduced (to one fifth its former level) to an acceptable level.

Lime Kilns

High quality lime for special purposes is produced in coal-fired shaft kilns. The kilns (see Fig. VII) are fired batch-wise and if smoke emission is to be avoided, the volatiles that are distilled off immediately the coal is injected into the firing zone must be burnt completely in an atmosphere rich with nitrogen and carbon dioxide before they are cooled in their passage up the kiln. With existing techniques this is virtually impossible and the kilns emit black smoke at regular and frequent intervals.

Over the years considerable technical effort has been applied to finding a solution to this extremely difficult problem. While it could be solved immediately by firing the kilns with coke rather than coal, the consequent increase in the cost of lime would be completely unacceptable to the users of this cheap basic chemical. Limited success has been achieved by injecting additional air into the combustion zone while firing, and modified firing techniques are being tried. Considerable progress has been made and the problem is being attacked vigorously.

General

The following additional measures have been implemented to ensure that atmospheric pollution is reduced to a minimum:

all chimneys in the Division have been fitted with continuous recording smoke density meters;

all steam locomotives have been replaced by diesel locomotives;

all chimneys built post-war have been some 50 per cent higher than previous construction.

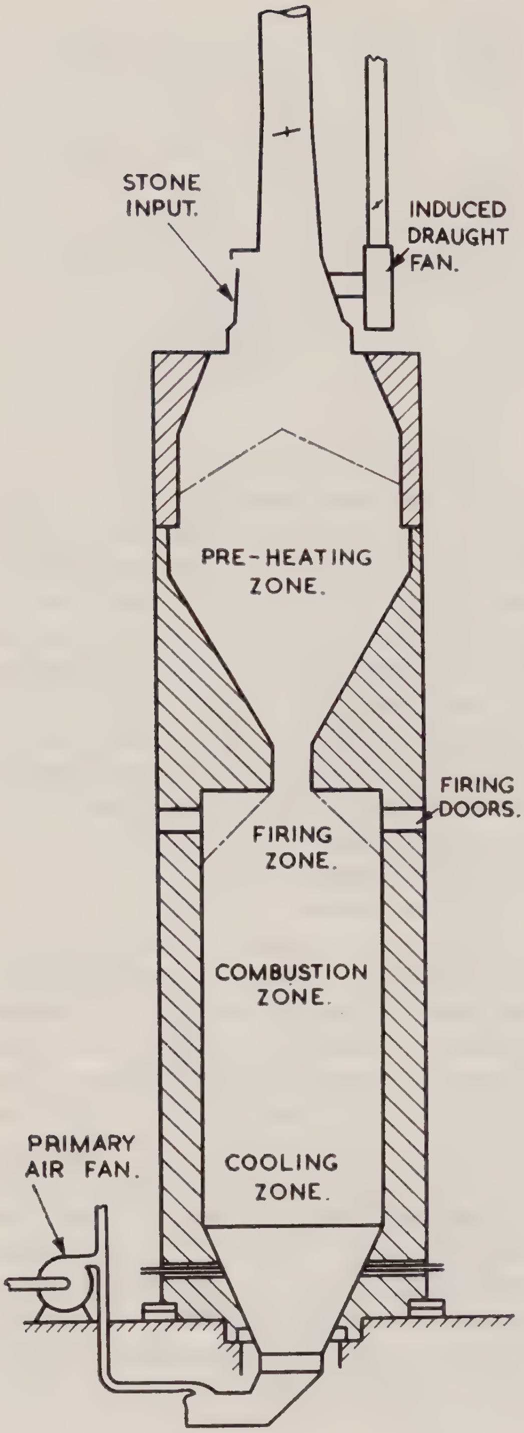


FIG. VII DIAGRAMMATIC ARRGT. OF COAL FIRED LIME KILN.

Cost

The investigatory work necessary to find ways of reducing atmospheric pollution to reasonable levels and the capital cost of the measures implemented have cost Alkali Division about £2 million since the war. And at the time of writing the further expenditure to which the Division is actively committed or expects it might have to spend over the next 5 years, amounts to nearly £0.75 million.

The possible total expenditure might, therefore, amount to about £2.75 million, or about £2/ton coal/year, a figure which agrees closely with the estimate of £2 to £4 given by Sir Ewart Smith in 1957[3].

Results Achieved

For the purposes of the Clean Air Act, supervision of the Division's plants is divided between the Local Authority and the Alkali Inspectorate* Both these bodies have always been kept fully informed at every stage of any investigations and of the remedial action proposed. Mutual confidence is of prime importance in dealing with problems of this nature.

The Alkali Division has now reached the stage when both supervising authorities have expressed themselves satisfied with the results of the measures applied and with those in train. It can be confidently claimed that when the measures now in hand have been completed, the Division will be complying with the Clean Air Act. Moreover, the level of atmospheric pollution around the works will be substantially lower than that which would have existed if only the bare minimum legal requirements had been fulfilled.

As an example of the progress made, in 1953 the weight of grit and dust emitted was about 18,000 tons/year; when the measures in hand have been completed this will have been reduced to about 4,000 tons/year for the same level of output (see Table 2).

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* It will be remembered that the Act provided for processes presenting special technical difficulty to be supervised by the Alkali Inspectorate, a body specially qualified for dealing with such problems. This facility does not confer any special privileges because the Inspectorate is equally well qualified to identify *genuine* technical difficulties.

		1953				After Completion of Agreed Measures			
Works	*Plant*	*Type of Firing*	*Type of Dust Arresting Equipment*	*Dust Emission tons/day*	*Smoke Ringelmann No.*	*Type of Firing*	*Type of Dust Arresting Equipment*	*Dust Emission tons/day*	*Smoke Ringelmann No.*
Winnington	'A' Station HP Boilers	Coal Chain Grate Stokers	2 Boilers: Skimmer Fans 4 Boilers: None	5·0	< 2	Coal Chain Grate Stokers	2 Boilers: Improved Skimmer Fans 4 Boilers: Multi-Cellular	1·0	< 2
	'B' Station HP Boilers	Coal Chain Grate Stokers	Multi-Cellular	1·0	< 2	Coal Chain Grate Stokers	Multi-Cellular	1·0	< 2
	Lime Recovery Plant	Pulverized Coal—Bin and Feeder Firing	Mechanical Medium* Efficiency Cyclones	25·0	< 2– > 4	Heavy Fuel Oil	Mechanical High Efficiency Cyclones	6·0	< 2
	Sodium Silicate Plant	Coal Gas Producer	None	0·1	2– 4	Heavy Fuel Oil	None	None	< 2
	Caustic Pots	Coal Coking Stokers	None	0·3	2– 4	Heavy Fuel Oil	None	None	< 2
Wallerscote	HP Boilers	Coal Chain Grate Stokers	2 Boilers: Skimmer Fans 4 Boilers: None	6·0	< 2	Coal Chain Grate Stokers	2 Boilers: Improved Skimmer Fans 4 Boilers: Multi-Cellular	1·5	< 2
	Secheur Plant	Chain Grate Stokers	None	1·5	2– 4	Heavy Fuel Oil	None	None	< 2
Lostock	HP Boilers	Pulverized Coal—Direct Firing	Multi-Cellular	9·0	< 2– 3	Pulverized Coal	Electrostatic Precipitators	1·0	< 2
	Finishing Plant	Coal Coking Stokers	None	0·6	2– 4	Steam Heated	—	—	—
Middlewich	IP Boilers	Coal Chain Grate Stokers	None	0·8	2– 4			—	—
	Finishing Plant	Coal Coking Stokers	None	0·2	2– > 4	Works	Shut Down	—	—
				49·5				10·5	
				18,100 tons /year				3,840 tons/ year	

Note: The outputs of the various plants have been adjusted to the same rates before and after modification
* Replacement of medium efficiency cyclones with high efficiency cyclones had started

The Outstanding Problems

Although complying with the Clean Air Act has cost industry vast sums of what is, so far as it is concerned, largely unprofitable expenditure, it must be recognised that it is a measure of very limited scope. The Committee on Air pollution[4] (the Beaver Committee) concluded that "the most serious immediate problem to be tackled is *visible* pollution by smoke, grit and dust"; while the deleterious effects of these pollutants cannot be denied, the Act is, to a large extent an aesthetic measure.

Even if smoke, grit and dust could be completely eliminated overnight, so long as fossil fuels are burnt, chimneys will emit vast quanties of combustion products—CO_2, CO, SO_2, SO_3 and unburnt or partially burnt hydrocarbons. The Beaver Committee recognized this situation but admitted that the problem could not be tackled with the state of knowledge then obtaining[5]. This situation is virtually unchanged today.

Whilst there is still a dearth of quantitative data, it appears to be generally accepted that SO_2 is the most harmful of the gaseous effluents particularly in association with smoke (although the part that hydrocarbons are now thought to play in the incidence of lung cancer—possibly aided and abetted by SO_2—must not be overlooked). Several methods of removing sulphur compounds from flue gases are known to be practicable and have been operated full scale:

at Bankside and Battersea Power Stations simple scrubbing processes using the alkalinity of river water to neutralize the SO_2 are used. Not only is there insufficient water available (if the rivers are not to be saturated with sulphate) to apply this process extensively, but the cost has been estimated to be 8-10 shillings/ton fuel[6]. This process would, for example, increase Alkali Division's operating costs by about £600,000 per year;

the Howden—ICI process has been tried at Tir John and Fulham Power Stations. In this process the SO_2 is removed by scrubbing the flue gases with lime slurry. Maintenance problems were severe and disposing of the wet calcium sulphate sludge was a nuisance. The cost of working this process has been estimated to be about 17 shillings/ton fuel[6]; that is, it would increase Alkali Divisions' operating costs by about £1m/year;

the Fulham—Simon Carves process has been tried at North Wilford Power Station. In this process the flue gases are scrubbed with ammoniacal liquor and the sulphur recovered as ammonium sulphate and elemental sulphur, both of which have a commercial value. But not enough ammoniacal liquor is available to work this process on a national scale and it is unlikely that there would be a market for the large quantities of ammonium sulphate which would be produced. This process was evaluated some years ago as a way of preventing SO_2 emission, but was found to be uneconomic so far as Alkali Division was concerned.

Apart from the economic disadvantages, all these processes would emit the flue gas cold and wet. Devoid of buoyancy, they would fall rapidly and undiluted to ground level in the near vicinity of the chimney; although free of SO_2 they would still contain all the other products of combustion—one nuisance would have been replaced by another.

Hot recovery processes are being investigated both by DSIR and CEGB; these would overcome the technical objections of the wet processes. The progress of this investigation is being watched with great interest but so far it appears that even if they can be developed successfully technically they are unlikely to be economic except for massive single sources of SO_2 emission.

The alternative to these recovery processes would be to build very tall chimneys. In this way, although SO_2 emission would not be prevented, it would be diluted to harmless concentrations before reaching ground level. But again the capital cost would be high; a conventional 500 ft. chimney costs about £200,000. And in locations such as Alkali Division—where a complex of large works is situated in a river valley and the chimneys are surrounded by tall buildings with adjacent river bluffs—specifying with any confidence the appropriate height for tall chimneys would be very difficult. Extensive wind tunnel investigations (and these are fraught with uncertainties) into topographical effects and an investigation into the behaviour of the lapse rates in the first thousand feet of the atmosphere would, at the very least, be necessary; meteorological factors (particularly inversion effects) that are notoriously difficult to investigate and predict play a significant part in the incidence of ground level pollution.

In recent years surveys of ground level SO_2 pollution have been made around the two largest Alkali Division works using a recording SO_2 meter. But even a survey for a year at five different sites has yielded information from which only the most tentative of conclusions can be drawn. To obtain information substantial enough to be used on a basis for specifying solutions to the problem of ground level pollution, several such instruments would be required for several years, together with comprehensive meteorological data.

In conclusion, while recognizing the importance of gaseous pollution, it is essential that bodies actively, and quite properly, interested in clean air be realistic. So far as the Clean Air Act is concerned, most major industries are probably by now complying. But in the present state of knowledge (or ignorance) and in the present economic climate, industry alone could not reasonably be expected to provide the enormous capital and operating expenditure which would be necessary to reduce significantly gaseous pollution. Possibly even the nation as a whole could not afford it. The present position is best summed up in a statement made recently in the House of Commons by the Parliamentary Secretary for Science[7]:

"Quite frankly, I have to tell the House that an economically acceptable solution to the problem of pollution by sulphur compounds is difficult to envisage unless some radically new brilliant ideas are produced".

The efforts of all those interested in clean air should be directed at ensuring that such an idea is produced as soon as possible.

Acknowledgment

This paper is presented with the consent of the Directors of I.C.I. Ltd. (Alkali Division).

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[5] Committee on Air Pollution. Report (1954) Cmd 9322. p.6.

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(2) THE WARWICKSHIRE CLEAN AIR COUNCIL:
AN EXERCISE IN CO-OPERATION

by

*B. D. Allen, D.P.A., M.R.S.H.**; *J. G. Calvert, M.A.P.H.I.*** *and R. K. Crow, B.Sc., F.A.P.H.I.****

SUMMARY

The constitution, history and activities of the Council, an advisory body of local authorities, are described. Activities relating to the administration of the industrial and the smoke control area provisions of the Clean Air Act are discussed, and an account is given of research initiated or supported by the Council.

1. The Constitution

THE Clean Air Council is a voluntary association of twenty Local Authorities in the County of Warwickshire. It was established as an advisory and technical body, with the object of abating the pollution of the atmosphere, and of assisting its member Authorities to implement the Clean Air Act, 1956. It is charged with:

(*a*) Undertaking investigations and research, and operating measuring instruments in the areas of the member Authorities.

(*b*) Arranging for the analysis of atmospheric pollution samples.

(*c*) Collaborating with and maintaining records for the Department of Scientific and Industrial Research.

(*d*) Advising constituent Authorities upon any technical matter in relation to atmospheric pollution.

(*e*) Arranging for publicity and staging exhibitions in relation to atmospheric pollution and clean air.

The Council meets quarterly, and consists of two elected representatives, appointed annually, from each Authority, together with officers, usually the Chief Public Health Inspector and the Medical Officer of Health. It elects annually from amongst the elected representatives a Chairman and a Vice-Chairman.

A Technical Advisory Committee is appointed from officers, and this group meets quarterly or more frequently, according to the business. This Committee is the main reporting body for the matters prepared by the various working groups now established under a sub-committee known as the Co-ordinating Committee. These three groups deal with publicity, pollution and measurement, and administrative and technical matters. Formerly the work was done by a single Technical Sub-Committee, and the value of this innovation has yet to be proved.

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* Chief Public Health Inspector, City of Coventry.

** Public Health Inspector, Rural District of Stratford-on-Avon.

*** Chief Public Health Inspector, Borough of Rugby.

The expenses of the Council are defrayed by the constituent Authorities on a rateable value basis, the apportionment being made according to values appearing in the Valuation List on April 1 of the year in which estimates of expenditure are submitted. An Honorary Clerk, Treasurer, and Publicity Officer are nominated, and an Analyst, who is paid on a fee basis.

2. A Short History

One maxim of the Warwickshire Clean Air Council is that "Smoke Knows No Boundaries". With the problem of a County area, industrial in the north, and rural in the south, with all parts experiencing atmospheric pollution, either as a home produced evil or as a "gift from the neighbours", the Local Authorities in Warwickshire knew that the evil had to be fought against. How better to do it than by a voluntary association of Local Authorities? This idea was commenced in January, 1957, by several Authorities. All the Local Authorities in the geographical County area (except Birmingham) became members, and the County Council agreed to co-operate, although it has no duties under the Clean Air Act.

The inaugural meeting of the Warwickshire Clean Air Council was held at the Council House, Coventry, in July, 1957, and thus the Clean Air Council was established to watch over the cleanliness of the air over 572,944 acres of territory, in which live 943,870 people.

Within the area are industries so diverse as to include car manufacture, cement making, textiles, charcoal burning, and aluminium smelting. Perhaps the greatest need was that of co-ordination of action to fight atmospheric pollution throughout the County. The Clean Air Council is the instrument devised to achieve this. *It is, in fact, an exercise in co-operation, by twenty Local Authorities.* Every type of English Local Authority is represented, except Parish Councils.

3. Measurement of Pollution

One of the first tasks undertaken by the Clean Air Council was to delegate to the Technical Advisory Committee the work of surveying the County area, in relation to sources of pollution. It then had to arrange for the siting of instruments to measure the extent of the air pollution. It was hoped that from this precise and accurate information would be obtained as to the nature of the problem in the County area.

Initially there were set up 20 daily volumetric measuring instruments, together with 35 deposit gauges, and 43 lead peroxide cylinders. All existing apparatus belonging to the various Local Authorities were taken over by the Clean Air Council. By 1962, the figures for the instruments sited in the area were 38 daily volumetric instruments, 52 deposit gauges, and 66 lead peroxide cylinders. These were to be maximum figures, for in 1962 there commenced a re-appraisal of all the measuring sites and methods. In addition, the usefulness of the deposit gauge and lead peroxide cylinders as indices of air pollution was under discussion. (*See map on page 68*).

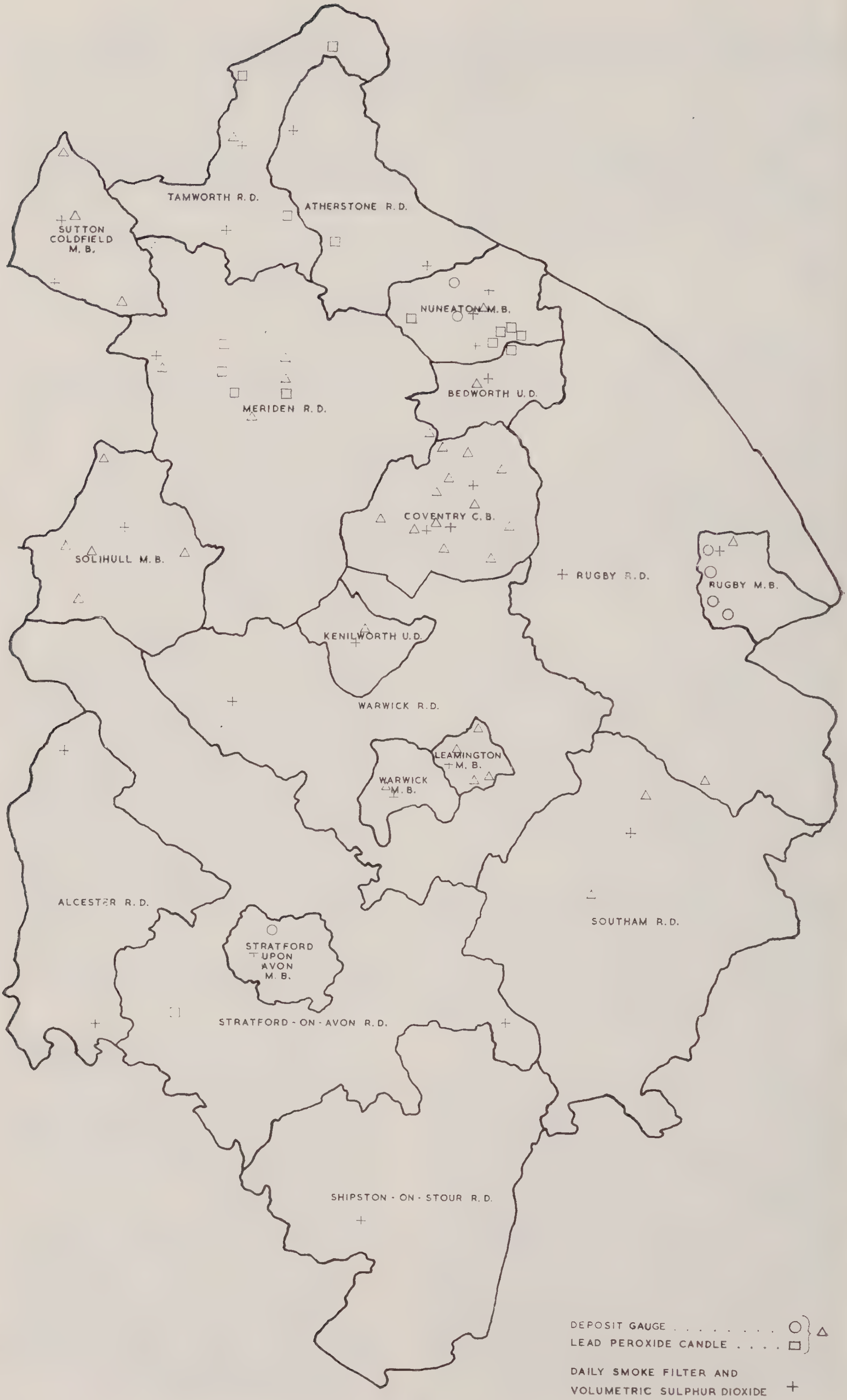
Opinion in the Technical Advisory Committee on the usefulness of these instruments was divided. The limitations on all instruments were recognized, but it was felt by the majority of the Technical Advisory Committee that the deposit gauge was, because of its faults open to criticism as a measuring instrument. The principal faults were:

(*i*) That the period of exposure (28 days) was too long to give trustworthy daily figures on average.

(*ii*) Wind direction greatly affected the deposit, and could not be taken into account in assessing the results.

(*iii*) The instrument only collected the coarser matter which would fall out of the atmosphere. Particles of under 10 microns in size would not be entrained.

(*iv*) Strong winds would take matter out of the bowl.


TAMWORTH R.D.
ATHERSTONE R.D.
SUTTON COLDFIELD M.B.
NUNEATON M.B.
BEDWORTH U.D.
MERIDEN R.D.
COVENTRY C.B.
SOLIHULL M.B.
RUGBY R.D.
RUGBY M.B.
KENILWORTH U.D.
WARWICK R.D.
LEAMINGTON M.B.
WARWICK M.B.
ALCESTER R.D.
SOUTHAM R.D.
STRATFORD UPON AVON M.B.
STRATFORD-ON-AVON R.D.
SHIPSTON-ON-STOUR R.D.
DEPOSIT GAUGE . . . . ○ } △
LEAD PEROXIDE CANDLE . . . . □
DAILY SMOKE FILTER AND VOLUMETRIC SULPHUR DIOXIDE +

In August, 1962, it was resolved that the Clean Air Council discontinue the use of deposit gauges, except in those cases where the officer responsible requested the retention of the gauge for specific purposes. The Technical Advisory Committee was to review each request made for the retention of a deposit gauge. The general intention was to leave the deposit gauge only as an assessment of pollution (grit) from industrial sources.

The lead peroxide cylinder was also criticized, and in view of its shortcomings and its general insensitivity, the use of this instrument is also being reviewed. The main criticism against these instruments was due to the alleged variation in absorption powers, caused by humidity, temperature, and wind speed. Linking these with the period of exposure makes it impossible to give any averages that are reliable. Some experiments were conducted, using what the Americans call a humectant. The results obtained over a twelve-month period throughout 1960 were most confusing, in that the results revealed at Nuneaton were markedly different from those obtained at both Leamington and Rugby. Use of the material compared with the standard preparation at Leamington and Rugby gave results over the period tested which were up to 56 per cent in excess of the results of the standard gauge. On the other hand, at Nuneaton no significant difference in results was obtained.

As will be seen in the discussion on research later in this paper, there is a body of opinion in the Technical Advisory Committee which holds that deposit gauges are not entirely useless. However, it was decided that whilst the deposit gauge was to be used as a specific purpose instrument, the lead peroxide cylinder should be superseded by daily measuring instruments. Wherever possible both instruments were to be replaced by daily volumetric instruments, measuring both smoke and sulphur dioxide. The problem of manning and operating daily instruments proved from the first a difficult one, and wherever possible they were sited in schools with science courses, or else in Council Offices. Each member Authority, through its Public Health Inspector, is responsible for the running of these instruments. These considerations are no longer acceptable in their entirety, as instruments are now wanted in areas where there are no such convenient operating facilities. There is now under consideration the question of putting in eight-port instruments, which will only need attention once per week. At present, the limiting factors on these are the cost and the extreme difficulty in setting up an instrument with a neat layout in a good, easily transportable mounting. At the present moment, two mountings of this type of instrument are under test, one in Coventry, and one in the Meriden Rural District Council area.

4. Administration of the Industrial Provisions

The responsibility for advising on this section of the work was delegated by the Technical Advisory Committee to a small Sub-Committee formed from nine of its own members. This Sub-Committee dealt with such problems as prior approval, chimney heights, and difficulties arising from combustion problems and grit emission. The operations of this small Sub-Committee were in practice extended to cover any industrial problem of air pollution, and each Authority found how useful this service was. Perhaps the greatest feature of its work was the fact that it led to a remarkable degree of uniformity throughout the areas of the twenty member Authorities when like conditions were encountered. The recent re-organization has replaced this Sub-Committee, and left the greater part of the work to be done by the full Technical Committee.

In 1959 a code of requirements was adopted for prior approval of fuel plants, based on a system operated in Coventry under a local Private Act. This differs from the recommendations of the Ministry of Housing and Local Government in that with bituminous fuels mechanical firing is required in all cases. Apart from obvious implications, any Local Authority which proposes to make the whole or major part of its district a smoke control area could not do otherwise.

The problem of chimney heights under Section 10 of the Clean Air Act caused difficulties in all areas. There was established, through this Sub-Committee, an advisory service which all member Authorities made use of, and applications in respect of chimney heights were dealt with by a formula devised in Coventry in conjunction with the Shell Oil Company. This was based upon the sulphur output of the installation in relation to the known ground level concentration of sulphur dioxide in the air.

Where an application is submitted for the purpose of approval by the Local Authority of the appropriate chimney height under Section 10, the applicant is also asked whether or not prior approval of installation is required. In giving the necessary details for one purpose, it has been found that the applicant usually elects to participate voluntarily in the prior approval scheme. This is advantageous when the abatement of atmospheric pollution has to be considered.

It is apparent that in order to operate Section 3 of the Clean Air Act effectively, a code of requirements is necessary, and all furnaces and auxiliary equipment should match up to standards based broadly on the fundamental principles of smokelessness and combustion efficiency before prior approval is granted. The code used by the Warwickshire Clean Air Council was formulated in Coventry, and has operated effectively (formerly under a local Private Act, and latterly the Clean Air Act, 1956) for over fourteen years. This code is not wholly rigid, except in a few basic necessities, such as requiring mechanical methods of firing for bituminous fuel, compliance with British Standards for liquid fuel installations, and provision, where necessary, of grit arresters and other instrumentation.

Such codes have always been suspect by manufacturers and allied engineering trade associations, on the grounds that local Authorities were attempting to interfere in matters not their concern, and opposition has, at times, been strong. Every effort has been made by the Clean Air Council to show that such accusations are quite unjustified, and rather than it being any positive attempt by a local Authority to influence designs, it has been stressed that the only aim is to ensure inclusion in the installation of appropriate composite parts, which are associated with smokelessness and/or a rapid diagnosis of any combustion trouble likely to cause air pollution.

The operations of the Warwickshire Clean Air Council have shown that pollution of the atmosphere can best be prevented by discussions between industrialists and local Authority officers, and the operation of Sections 3 and 10 of the Clean Air Act provide the necessary talking points in matters of great concern to both parties.

5. Administration of Smoke Control Area Provisions

A function of the Clean Air Council is to further the drive for clean air by encouraging its member Authorities to establish smoke control areas. The advisory service of the main Technical Committee was extended to deal with problems arising in particular Authorities' areas where smoke control areas were planned. Here again, uniformity in the administration of the sections of the Clean Air Act dealing with smoke control areas is a desirable feature to be achieved.

Part of the Warwickshire Clean Air Council's area contains Authorities designated as "black areas" in relation to air pollution. These areas were given in the Interim Report on Air Pollution, published in December, 1953, as Command Paper 9011. The Authorities concerned are Coventry, Solihull, Sutton Coldfield, Nuneaton and Bedworth. It was deemed desirable that smoke control area programmes should commence in the "black areas" first, but it was to be the Warwickshire

Clean Air Council's policy that the other Authorities were also to be encouraged to prepare and operate smoke control areas. Two Authorities —Leamington Borough and Warwick Borough—not designated as "black areas", were quickly off the mark, and both inaugurated smoke control areas.

However, the change to clean air in Warwickshire was not to run as smoothly as every member of the Clean Air Council had hoped. Every Authority intending to make smoke control areas arranged its programme, and started work in the period 1957/58. North Warwickshire is on a coal field, and, as in other parts of the country, opposition in the mining communities to smoke control increased rapidly, and became a dominant factor. There was fear in the Warwickshire mining community that the local coal not being of a type then recognized as suitable for carbonization, might mean unemployment for them. It is perhaps true to say that they did not dispute that the air above their towns was polluted, but education had been insufficient to convince them of the great social need to do something about it. Later, unfortunately, despite the measurements taken of their air pollution problem, two prominent towns—Leamington (which had been such a vigorous champion of clean air), and Solihull—decided in 1961 that for the time being their pollution problem was not to be tackled, and their programmes were brought to a standstill. As in other parts of the country, difficulties arose in Warwickshire due to alleged fuel shortages, and the public reaction because of misinformation was strongly against coke.

Progress on smoke control areas was lamentably slow, for at the end of 1961 only nine areas had been confirmed, and the total number of premises included was 8,379, covering 2,202 acres—a very poor effort for five years' work. The slow progress was due to opposition, which necessitated public enquiries, resulting in delay, public apathy, and lack of knowledge by elected representatives, together with the failure of the officers concerned to make the case for clean air strong enough, and keep on making it. All too many officers were either themselves unconvinced about the great social evil of polluted air, or, if convinced, lacked the drive and incentive to convert others. It is a tough battle to get any good cause established and accepted. Smoke control is an even tougher battle, because it is a struggle against tradition. The average Britisher sees nothing wrong in the inefficient way he has heated one corner of his home in the manner used for past centuries.

Enlightened members battled on in the Warwickshire Clean Air Council, and perhaps by the end of 1961 the tide started to turn. At the request of the Minister of Housing and Local Government, programmes for smoke control areas were revised in the Spring of 1962, and once more a drive was started. It is anticipated that by the end of 1963 some 21 areas will be operative, with some 28,579 premises, covering 9,079 acres of urban development. This programme is expected to be fulfilled. It is not good enough, but certainly the last two years have shown a better result than the previous five.

All, however, still does not go smoothly. Leamington Borough has not resumed its smoke control programme, and the operation of the existing orders has become almost impracticable, owing to a policy decision of the Council. Nuneaton Borough, after making a very vigorous start, also hesitated, and is not to move any further forward because of the fuel distribution difficulties experienced during the past severe winter.

Without doubt one can say that as far as smoke control areas are concerned, the slow rate of their establishment must be counted as one of the Warwickshire Clean Air Council's failures. However, one can imagine how poor the position would now be, had the Warwickshire Clean Air Council never existed.

Perhaps the greatest complaint against smoke control has been that of the lack of reactive fuels. No-one wants to establish areas until there are literally millions of tons of the more reactive fuels available. The sad truth is that no manufacturer is going to expand capital on plant to produce that fuel in such quantities unless the smoke control areas are available and operative. This is due to the fact that until such areas have been established there is no guaranteed market for a highly reactive fuel if produced in large quantities. This is the vicious circle of our economic system, and there seems no way out of it at present.

The current investigation by the Government into future supplies of smokeless fuel is again having a delaying effect on the establishment of new smoke control areas.

How far has co-operation worked in the Warwickshire Clean Air Council in respect of smoke control areas? There has, at all stages, been a useful sphere of co-operation, and exchanges of ideas, methods of working, and pricings for adaptations in houses, and this has helped all officers and Councils concerned. Let us be frank, and say that there is room for even greater co-operation, and in relation to smoke control areas this must be tied up with publicity and education in relation to clean air.

6. Publicity

One aspect of clean air which might well be regarded as the linch-pin of the matter is publicity. This was recognized from its inception by the Warwickshire Clean Air Council, and steps were soon under way to achieve this aim.

The first step was to form a panel of speakers to address organizations such as the Women's Institutes, Townswomen's Guilds, and any other body who were prepared to invite our speakers. Following on this it was decided to provide a stand which could be used at exhibitions either by the Council itself or by any of the member Authorities. After some experiment

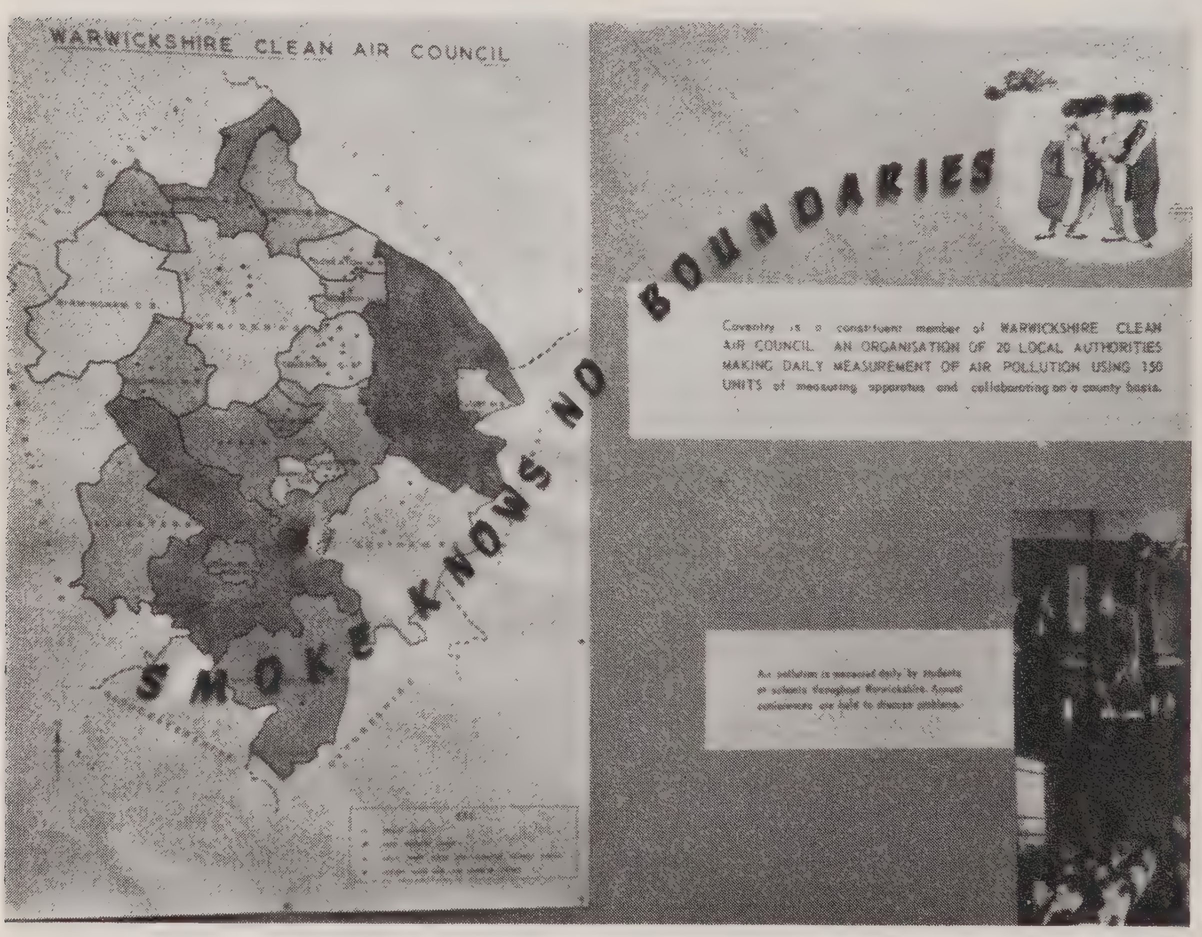

WARWICKSHIRE CLEAN AIR COUNCIL
SMOKE KNOWS NO BOUNDARIES
Coventry is a constituent member of WARWICKSHIRE CLEAN AIR COUNCIL AN ORGANISATION OF 20 LOCAL AUTHORITIES MAKING DAILY MEASUREMENT OF AIR POLLUTION USING 150 UNITS of measuring apparatus and collaborating on a county basis.

Figure 1. Display panel used by Warwickshire Clean Air Council

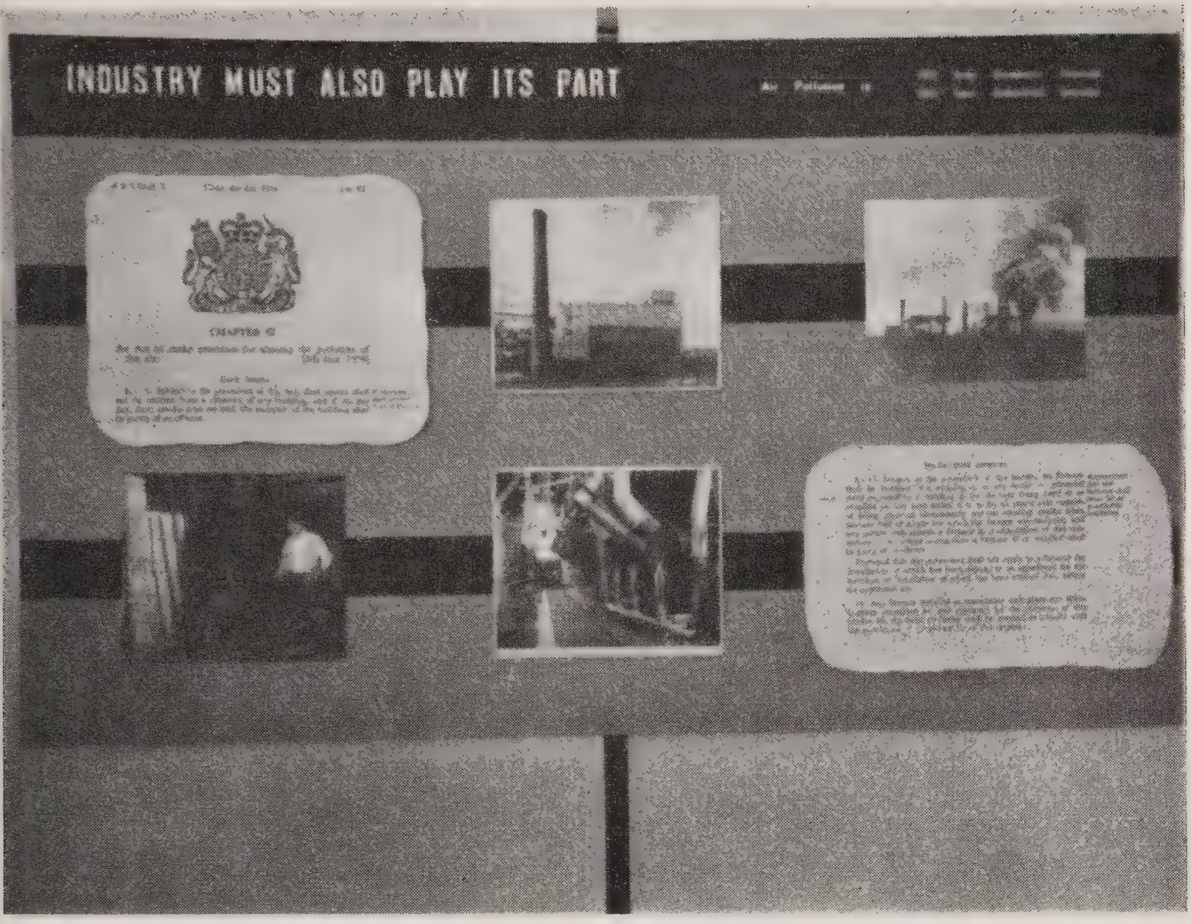


Figure 2. Display panel featuring industrial pollution

this was designed to be sectional, so that it could be used either in whole or in part, according to demand and space available. Material is provided in part by the Warwickshire Clean Air Council, with space also available for items of local or topical interest.

To convert the youth of today is to convince the adult of tomorrow, and with this principle in mind, and also as a thank-you gesture to those schools who have operated the daily volumetric instruments, a series of one day conferences for senior pupils at Warwickshire and Coventry schools has been convened. These have taken the form of lectures, films, practical demonstrations, and discussion programmes, and have been very successful to date. Each schoolchildren's conference has been attended by some 150—170 scholars in their last two years of schooling. The interest shown has been reflected in the keenness of question time at the end of the day.

The Technical Advisory Committee some time ago were concerned about letters, often highly critical of smoke control measures, being published in the press, and remaining unanswered. These were giving a distorted and one-sided view of the facts, and the old age pensioner with a meagre teaspoonful of fuel figured very largely in their presentation. Difficulty arose as all the officers concerned with the Warwickshire Clean Air Council are employed by Local Authorities, and ethically should not indulge in personal newspaper controversy.

Having given a lot of thought to this problem, the Committee, as a first step, sought the help of national bodies operating a press service, in the hope that they might undertake to reply to these critics. As topicality is a necessity, it was therefore decided to appoint a press officer, who would reply on behalf of the Council. This was done after consent had been received from the employing Authority of the officer to allow him to make an immediate answer to these criticisms.

Visual aids for speakers are a well recognized and valuable asset, and to assist in this respect, there has been compiled a series of colour slides of buildings, vegetation, industrial plant and schools, etc., in which some aspect of atmospheric pollution is exemplified. The publicity section is now contemplating the production of tape recordings, which could be used in conjuction with selected slides.

Amongst the other functions of the publicity section is the duty of liaison with the electricity and oil industries, the National Coal Board, the Solid Smokeless Fuels Federation, and the local branches of the Coal Merchants' Federation and the Coke Distributors' Association.

7. Research

The Warwickshire Clean Air Council is fortunate in having an Analyst whose horizons are not bounded by conventional examination of air pollution instruments, but extends far beyond it. As the account which follows will show, he and his enthusiastic team have used the laboratory facilities at their disposal to extract the utmost information from the data collected by the Public Health Inspectors.

On the 29, January, 1959, after consideration of the officers' joint report on the Analyst's paper entitled "Radioactivity—Public Health", the Warwickshire Clean Air Council instructed their Analyst to report twice yearly on the level of total beta radiation in the rain water collected by the deposit gauges.

The laboratory facilities available did not permit a separate estimation of individual radio-isotopes to be made at that time, but did permit the measurement of beta activity in total amount in a particular sample of rain water.

Total beta activity consists of a mixture of both natural and artificial radioactive elements, but natural activity due to Potassium 40 was determined and deducted from the gross activity, thus giving a true assessment of total artificial beta activity of the sample.

Some artificial radioactivity consists of radio-isotopes such as strontium 89 with a short half life (58 days), and others like carbon 14 with long half lives (5,500 years). By retaining collected radioactive material and recounting it over regular periods of time, the

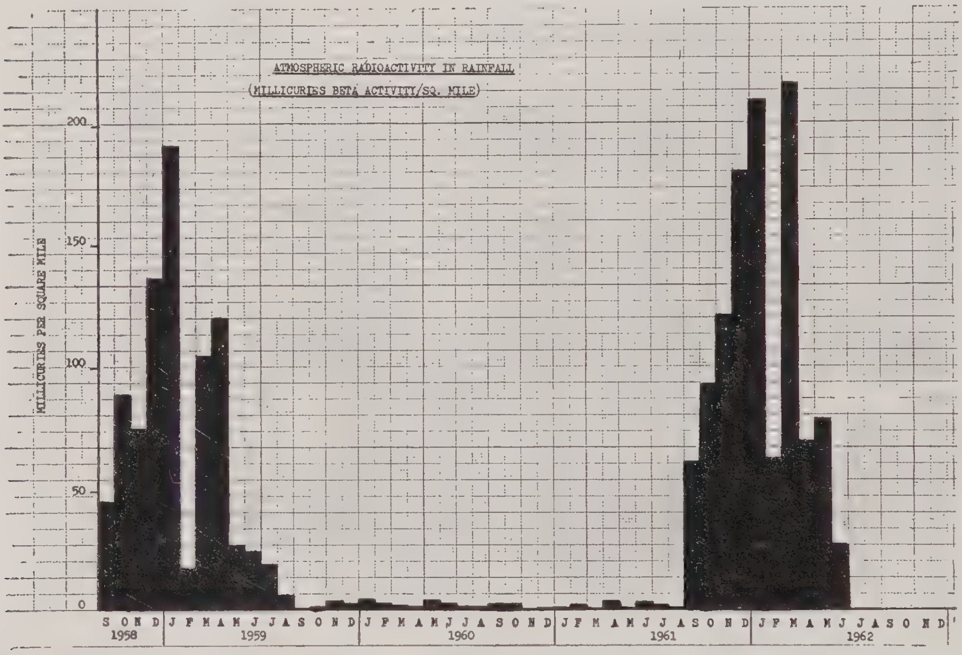


Figure 3. Radioactivity—in the Atmosphere: Total Beta Radiation in Rain Water from Deposit Gauges

elements with short half lives decay, leaving only the isotopes with longer half lives. It is generally agreed that the more persistent radioactive isotopes constitute the greater hazard to human health, because their action is accumulative because of their persistent nature.

Rainfall pattern is variable geographically and seasonally, and consequently to equate the artificial beta radiation to the volume of rain did not appear appropriate. Hence it was decided to express the amount of radioactivity, as with other atmospheric pollutants, at that time, in terms of activity per square mile.

Rainfall immediately following nuclear explosion washes from the atmosphere a greater proportion of the short life isotopes which, in the absence of rain, would decay naturally in the upper atmosphere.

A sudden or sharp increase in total artificial beta activity occurring in rainwater does not, therefore, mean that the hazard from "fall out" has seriously increased.

The rainwater collected in the normal deposit gauges distributed throughout Warwickshire is bulked, and a representative portion used for the assessment of total beta radiation. The solid residue is then stored in the laboratory and allowed to age. At chosen time intervals it is re-examined for the level of remaining more persistent radioactivity, the short half life radioisotopes disappearing the longer the sample is stored. For some time the method of evaluation of the levels of the more hazardous isotopes, i.e., those possessing a relatively long half life, was to undertake a pattern of recounting and thus establish decay curves for each month's material. It became apparent that even after laboratory storage times approaching twelve months subsequent to collection date, very little further decay had taken place. Monthly recounting was therefore discontinued at the end of 1961, because atmospheric weapon testing was not being practised in this period, and the material contaminating our gauges had aged for three years in the atmosphere, being derived from the series of tests which terminated in the Autumn of 1958.

Nuclear weapon testing was resumed in 1961, and the attached histogram clearly reveals the upsurge in radioactivity recorded in the rain water collected throughout the County, which persisted almost uninterrupted until April, 1962, when the contamination was comparable to that experienced in November, 1958.

The Analyst, in his report to the Council, has repeatedly emphasized that these measurements are of total beta activity, and that although as such it includes the persistent and medically more hazardous radioisotopes, the information must not be interpreted as being a direct measure of the latter.

However, the presence of persistent hazardous radioisotopes can be quite clearly demonstrated in the rain water collected, and as all radiations are potentially dangerous, constant and close scrutiny of the levels to which we are being subjected would seem to be rational and justifiable.

Fluorides in the Atmosphere

Other lines of investigation which have been pursued using the normal measuring instruments for collection purposes, have been the evaluation of fluorides, lead, ammonia, iron and potassium in the atmosphere.

Of these, space will only permit brief discussion of two examples, fluorides collected in the British Standard deposit gauge, and lead collected in the filter papers of the daily volumetric instrument.

The value of a fluorine intake of one part per million in public water, supplied to children up to the age of eight years as a preventative of dental caries, is well known to public health workers. So also is the occurrence of fluorosis in cattle, where the usual traces of twenty parts per million dry weight is greatly exceeded in grass.

Since July, 1961, the rainwater collected from fifty-two deposit gauges scattered throughout the area controlled by the Warwickshire Clean Air Council has been examined to find whether fluoride is a variable factor in air contamination.

Several thought-provoking questions occur when carrying out an investigation of this nature—what sources of fluorine contamination of the atmosphere might there be in addition to metallurgical processings? What level might one expect in areas considered "free from such pollution"? Because of the unique co-operation which exists within the Warwickshire Clean Air Council, full facilities are available for answering many such questions. As the various gauge results came to light, it was quite obvious that some locations were suffering a more intense contamination by this element than others. The Chief Public Health Inspectors were contacted to ascertain the location of metal smelting industries in their area, particularly that of aluminium smelting.

It would not be unrealistic to assume that the level of pollution from this particular contaminant would be at a relatively high level in the industrial areas of our more densely populated municipal authorities.

Our results over the twelve months indicate that of the least contaminated gauges, four are sited in an industrial/urban area, housing a diversity of light industry.

The returns from these four gauges for each month were consistently lower throughout the whole period than the monthly average value for all the fifty-two gauges. One gauge, returning a yearly total which classified it within the least polluted set, is obviously on particular and infrequent occasions receiving pollution from a point source the fluoride level of this gauge during the month of March, 1962, for example placing the gauge amongst the list receiving the heaviest contamination.

This phenomenon, as might be expected, is not peculiar to this particular gauge. Others, also among those examined, have grossly varying levels of contamination, and in particular one gauge, occupying a very prominent position among the list of heavily polluted gauges, received during two months, i.e., October and January, very little contamination by fluoride.

During the twelve months of our investigation, results monthly determined on the level of contamination in each of the fifty-two gauges yielded an average monthly fluoride value throughout the County of 426 milligrams per 100 square metres of exposed surface. The County average for the year is, therefore, slightly in excess of 5 grammes (5·106 gms.) per 100 square metres.

Obviously this value has been calculated incorporating results from gauges registering a wide divergence of results, and those gauges which were least affected by this pollutant were found to yield results over the year as low as 2 grammes per 100 square metres.

As might be expected, the area throughout the County most troubled by fluorine emission is a Municipal Borough where the particular gauge is sited to record the nuisance resulting from the activities of an aluminium works.

Over the twelve months reviewed, this gauge recorded a total fluorine contamination of some 13 grammes per 100 square cms., a value two and a half times in excess of the average of the County, and more than six times greater than the area least affected by this pollutant.

Set out below are results of the six gauges in the County registering the greatest fluoride contamination, with the number of monthly occasions throughout the twelve when results have appeared in the gauge list of six most contaminated for the County.

The table also sets forth the monthly average value and the total annual value of fluoride contamination for these particular gauges.

What level of fluoride in the atmosphere is acceptable as one free from nuisance is a somewhat debatable topic. Has the atmosphere to be such that no toxic or harmful results would ensue as the result of continuous inhalation during a period of twenty four hours? Should an acceptable atmosphere contain fluorine at a level such that

Gauge Pos'n.	*Public Health Inspectors' Comments*	*Number of Occasions in list of 6 highest*	*Monthly Average mgm/100 sq. metres*	*Percentage of County Monthly Mean*	*Total Annual Deposit gms.*
1	Municipal Borough: gauge placed "in direct line of aluminium works" . .	12	1,078	253	12·9
2	Rural area to South of County: "within vicinity of two large cement works and some small aluminium works" . .	11	900	211	10·8
3	Rural area—"gauge situated South of an aluminium works; also in area of ceramic manufacture" . .	8	699	164	8·4
4	Urban area: "situated to record emissions from local cement works"	9	690	162	6·9
5	Rural area: low population "gauge sited to record emission from two cement works and aluminium works" . .	9	596	140	7·2
6	Urban area: "deposit gauge located centrally"	6	503	118	6·0

Table 1. The six highest fluoride contamination figures

no damage to plant life would result? Examination of the literature dealing with this chemical as an atmospheric pollutant is to say the least not very helpful when considering acceptable limits.

It can be contended that levels as determined by us by deposit gauges may not be strictly comparable with those set forth in values per cubic metre air, or as parts per million; nevertheless, it is reasonable to assume that areas registering enhanced values via deposit gauge measurements are, in fact, subjected to substantial atmospheric fluorine levels, which in one instance is some two and a half times the average County level.

Lead in the Atmosphere

Although in this country the number of cases of lead poisoning recorded per annum is only about fifty, it is probable that many more cases are never diagnosed. The fact that lead once ingested is stored in the body indicates a poison of cumulative properties, which cannot be ignored.

In an attempt to determine levels of lead existing in the atmosphere, we chose to examine samples of material collected from two locations in the County which one might consider to be reasonably free from an excess of such contamination. In both instances this was only possible with the full co-operation of the Chief Public Health Inspector concerned.

The first site was the Municipal Borough of Stratford-upon-Avon, where the air filter intake is some forty feet above ground level, overlooking

Month, 1960	*Lead* *Stratford*	*Lead* *Shipston*	*Smoke* *Stratford*	*Smoke* *Shipston*
January	1·7	0·2	6·5	2·6
February	Nil	0·2	7	2·5
March	0·1	Nil	6	—
April	1·0	0·1	3	2
May	0·2	0·2	3	1
June	1·3	Nil	3	1
July	1·1	Nil	1	Nil
August	4·9	1·5	4	1
September..	0·5	Nil	6	1
October	5·0	0·6	11	2
November..	5·0	1·4	13	3
December..	1·6	Nil	23	10
Total	22·4	4·2	86·5	26·1
Average	1·9	0·4	7·21	2·37
	Ratio: 4·8		*Ratio: 3·0*	

Table 2. Lead and smoke in the atmosphere

the Market Square, which is normally used as a car park. The second site chosen for comparison purposes was Shipston-on-Stour Rural District. Here the air filter intake is conventionally sited some fifteen feet above ground level at a school situated on a class 3 road, carrying very little motor traffic between Shipston-on-Stour and the village of Ilmington.

The instrument sited at Stratford-upon-Avon, although at an excessively high location, has on frequent occasions been responsible for registering higher than normal smoke values, and in the Table set forth, which covers the twelve months of 1960, are incorporated values for smoke in addition to the metal lead for both of these sites. All values are recorded as micrograms of lead and smoke per cubic metre of air.

It will be observed that the average level of atmospheric lead contamination experienced at the site at Stratford is on average nearly five times greater than at Shipston-on-Stour. It may well be, however, that at the normally recommended fifteen feet level of air intake, the lead contamination in the atmosphere at Stratford may be even higher than those we have recorded.

A rather peculiar value found, which it might not have been possible to forecast, is the ratio of smoke to lead at both sites, and the values obtained raises a very interesting question—whether areas experiencing the greatest nuisance from smoke are suffering also a proportionately relatively high level of lead contamination? Only systematic examination of these areas will reveal whether this is indeed so. Having obtained such data as this, one is then faced with the very real and proper but nevertheless vexed question oft times unanswerable—what contamination level should be tolerated?

The human body is known to be capable of accepting certain poisonous substances, and excreting these at a reasonable rate to ensure that the body suffers no ill effects, and it has been calculated, especially in relation to lead contamination in foodstuffs, that between 1 and 2 milligrams of the metal lead may be ingested daily without ill effect. The proviso is made, however, that the length of time ingestion of such levels is continued is an influencing factor. The daily amount of lead ingested is obviously the sum of the minute quantities present in the components of the diet, each of which may contribute apparently insignificant amounts, but the total daily intake in food may in the course of time add up to a possible health hazard. Elimination of lead from food and drink would thus remove a potential hazard providing also the intake from other sources was negligible. In general, levels of lead contamination in water and foodstuffs is rigorously controlled in an effort to eliminate entirely such contamination, and in foodstuffs a limit of about one part per million generally operates.

Again, generally speaking, approximately 2 lbs. of food is consumed per person per day, and a rapid calculation reveals, assuming the restricted level of 1 part per million is never exceeded, a daily intake of about one milligram. In other words, under the most favourable conditions the level of lead has been reached which it is considered is that with which the human body can adequately deal. Who knows what the lead contamination may be in a home-brewed elderberry or rhubarb wine, to mention one commodity over which no control is exercised? Add to this the chewing of pencils containing lead in the pigment of the lacquer, and the very many other ways in which this ubiquitous metal may enter the human body, and it immediately becomes apparent that the less lead we inhale via the atmosphere the less hazardous will be our existence. How much lead do the people inhale who either live or work in thoroughfares conveying heavy motor traffic?

Atmospheric dust contains at least three substances believed to be carcinogenic, arsenic, benzpyrene, and radioactive material. Pybus (1959) stated that everything—air, vegetation, streets, houses, food, people—is contaminated by smoke and soot. The Technical Advisory Committee are acutely aware of this. Radioactivity and benzpyrene are being looked at, and no doubt arsenic will be an early candidate for investigation in Warwickshire air.

An Electrostatic Dust Monitor

There has been a great deal of discussion in the Warwickshire Clean Air Council about the value of our measurements, but it is inescapable that the concentration of pollution at ground level, depending as it does on the effect of weather as to its distribution, must always be measured externally, i.e., by methods such as those in use at present, the British Standard deposit gauge and the volumetric smoke filter.

From the smoke inspection point of view, means of measurement in the flue of industrial plants has long been an ideal. Section 4 of the Clean Air Act empowers the Minister to make regulations imposing requirements as to providing and installing apparatus for this purpose. The Minister has not yet exercised these powers, presumably because he is not satisfied that a really foolproof apparatus is available.

It is to this aspect of the problem that our friends at the A.E.I. Research Laboratory, Rugby, have devoted a great deal of research. Apparatus which would respond to particles of diameter down to 0·1 micron, and which would integrate the total surface area of all particles discharged in a given time was desired. This equipment had to monitor smoke continuously, and be capable of being installed in a chimney duct.

This work* at Rugby has resulted in the production of an electrostatic type of dust measuring apparatus, which monitors the total surface area of all dust passing a pre-selected point in the flue duct in unit time. The apparatus which takes account of the velocity of the flue gas therefore provides a measurement of the rate at which a chimney is polluting the atmosphere.

The A.E.I. dust monitor is designed for recording the dust burden rate of flue gases in power stations, especially those burning pulverized fuel. Such monitors have been in operation for periods of more than two years, and have required virtually no maintenance.

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* D. H. Grindell, Ph.D., B.Sc.(Eng.), A.K.C., Grad.I.E.E., Warwickshire Clean Air Council, Rugby, October 1961.

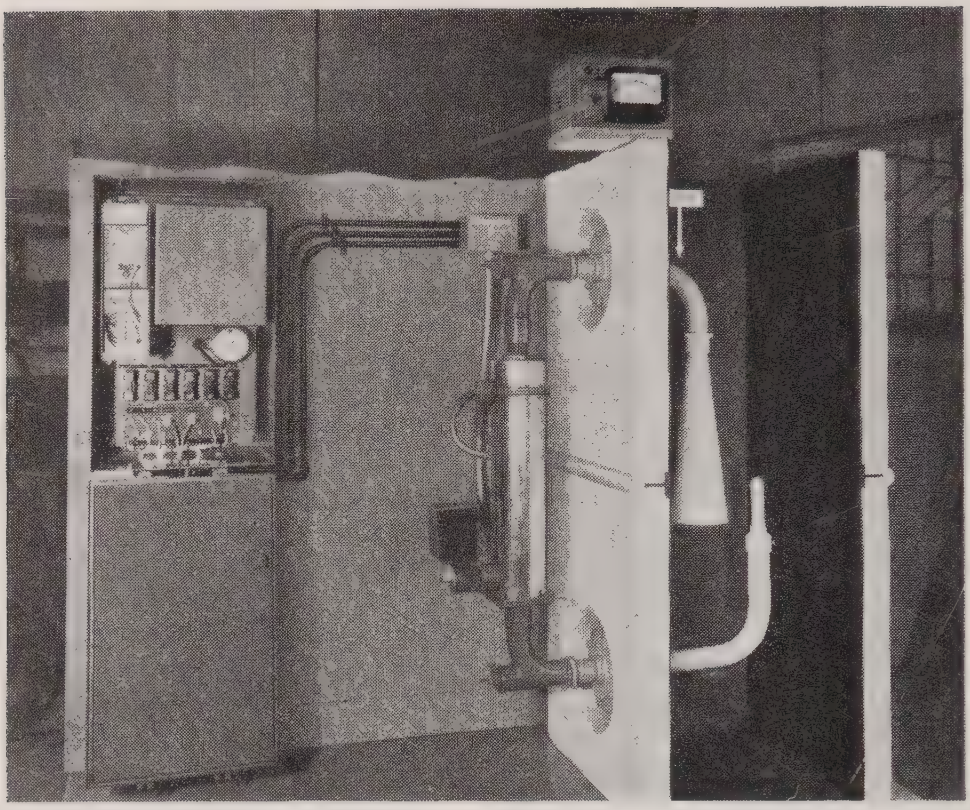


Figure 4. An AEI dust monitor set up for exhibition purposes, showing the manner in which the sampling and return pipes pass through the flue-duct wall

The unit is fitted into the flue duct wall (photo 3.) In principle the A.E.I. dust monitor measures the electrostatic charge transported by dust particles, and to this extent resembles the electrostatic precipitator used for gas cleaning in power stations and other large installations. It is completely automatic, and provides a continuous chart record of dust emission, and can be set to sound an alarm or operate a flashing light, should the emission exceed the preset value for longer than the predetermined time.

It indicates a higher reading when there is an increase in the flow rate of dust laden gas, even if the dust content per unit volume (the quantity which would be determined by a photoelectric smoke density meter) remains unchanged. An increased rate of coal consumption in an efficient boiler system results in an increased volume of flue gases. Since the recording is of surface area per second, the A.E.I. dust monitor detects this change, whereas the photo-electric cell does not.

Likewise, for a given weight of dust, a higher value is indicated for small particles than for larger particles.

This greater sensitivity to smaller particles is of paramount importance to air pollution, because it is the finer particles that remain longest in suspension, reducing sunlight, and forming the nucleus of those chemical fogs which, when inhaled, are capable of reaching the lower respiratory tract and causing damage.

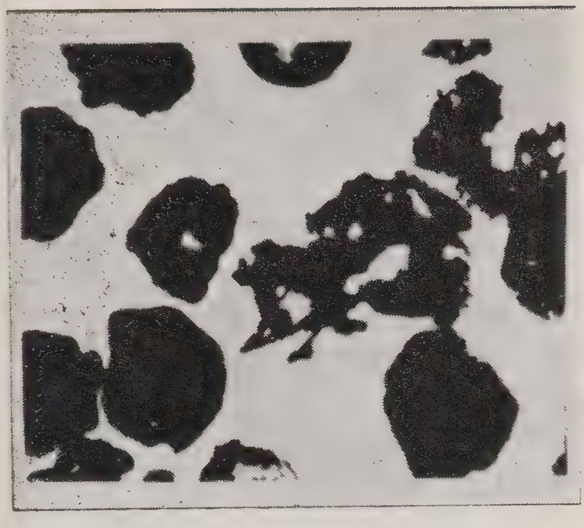
Field Trials

This aspect of research has not been neglected, and trials have been made of the following matters:-

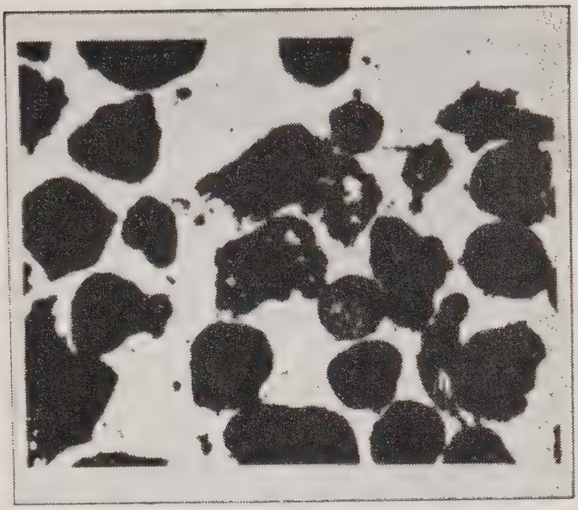
(*a*) Cost comparisons of solid smokeless fuels available in the area for domestic use.

(*b*) Testing of methods for smokeless ignition of fires include proto-type electric igniters.

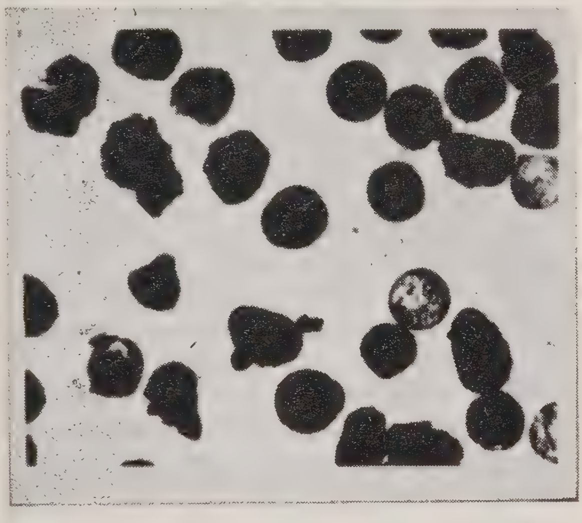
(*c*) Ignition tests on solid smokeless fuels.



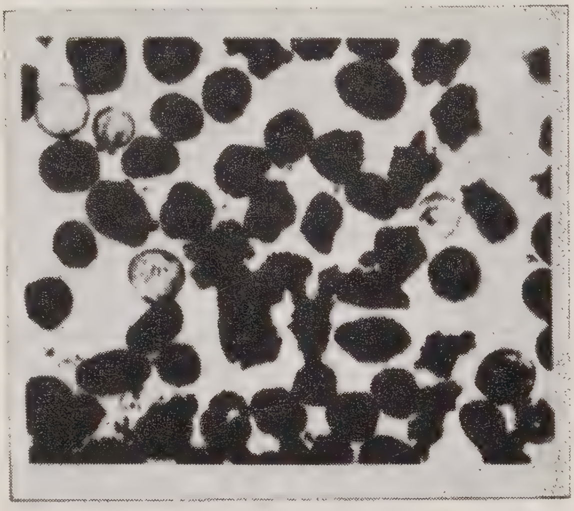
Fly ash retained on mesh 100 sieve greater than 150 microns. X130



Fly ash which passed through mesh 100 sieve and was retained on mesh 170 152-89 microns. X130



Fly ash which passed through mesh 170 sieve and was retained on mesh 200. 76-89 microns



Fly ash which passed through mesh 200 sieve and was retained on mesh 300. 76-53 microns

(*d*) Development of eight-port volumetric instruments.

(*e*) Comparison trials of volumetric instruments running in parallel.

8. Benefits of Co-operation

The main factor that has emerged from the work of the Warwickshire Clean Air Council is proof that air pollution can be county-wide, and that the maxim "smoke knows no boundaries" is not just a trite saying. The years of work on measurement in Warwickshire have shown just how much the smoke and pollution from one Authority can adversely affect the air of a neighbour. The co-operation on air pollution control in Warwickshire has brought a uniformity of action involving twenty Local Authorities in relation to the measurement and assessment of atmospheric pollution, and also in relation to industrial smoke problems. This uniformity has aided not only Local Authorities, but also industry, and in the latter case industrialists have known that to whatever area of the county they contemplate moving, requirements in relation to the Clean Air Act will be standardized, and prior knowledge can be obtained.

In relation to measurement, one of the benefits of co-operation has been the saving in bulk buying of instruments and the improvements effected in instruments. Daily smoke and volumetric apparatus are quite expensive, but, through the work of the Clean Air Council, some 50 per cent. of the cost of these instruments has been saved by hiring meters and bulk buying of the rest of the instruments. Savings were also effected upon deposit gauges and lead peroxide instruments. It is estimated that the total saving for all the instruments when they were being purchased was some 32 per cent. of the original estimate.

Another direct benefit of co-operation was the wide diffusion of information amongst the twenty member Authorities. Advice on almost any problem relating to atmospheric pollution can be given, annual and quarterly reports are published for the dissemination of information, and these include reports on various topics, for example, the medical aspects of atmospheric pollution.

Within the organization there are good facilities for joint research. This has been undertaken both in the technical field and also in the laboratory by the Analyst, of which mention is made in this paper under the subheading of research.

There has been good liaison with the smokeless fuel producers, the Coal Board, Gas Board, etc., and also the manufacturers of approved appliances. This liaison has probably been more detailed and wider in extent than it would have been from any single Authority in the Warwickshire Clean Air Council, because so much more ground can be covered in discussions and interviews when dealing with a collective rather than an individual body. Liaison through the Council with the District Alkali Works Inspector has also been good, and beneficial to all parties. In addition, the Clean Air Council is represented on national bodies and at conferences concerned with atmospheric pollution. There has been, throughout the area of the twenty member Authorities, good co-operation with Local Authority architects, and this has helped to reach proper standards in relation to fuel burning appliances in Local Authority buildings.

It can be said in all truth that the Warwickshire Clean Air Council, insofar as the Clean Air Act is concerned, has bridged the gap with co-operation that exists between the County Council architects and planners, and the officers in the district Councils who deal with this statute, i.e., the Clean Air Act.

One indirect benefit of co-operation relates to the building byelaw which Authorities can make under Section 24 of the Clean Air Act to enable new buildings to be fitted with grates that will burn smokeless fuel. This byelaw is permissive, but the efforts of the Clean Air Council have resulted in eighteen out of twenty of the member Authorities adopting the byelaw. Two Authorities, Stratford-on-Avon and Shipston Rural District Councils, have so far failed to adopt the byelaw.

The Warwickshire Clean Air Council has encouraged and assisted in the organization of courses in relation to clean air. The main interest in courses has been for fixers of approved appliances. This is one aspect of the building trade which is only making slow progress, yet is vital to the success of the smoke control programmes.

The co-operation that has extended in the technical field has also been extended into the scientific field, in that full facilities are available to all member Authorities for the analysis and testing of fuel. As yet little use has been made of these facilities, but without doubt they will be called upon more and more in future years as the quality of fuel will largely control the effectiveness of the battle against atmospheric pollution.

9. Conclusion

The work of the Warwickshire Clean Air Council is described and discussed in this paper, examples of research undertaken are given, and some of the benefits of this exercise in co-operation are given. The authors claim no personal credit for the work described in this paper. The task of sifting the product of five years' operation, selecting representative samples from it, and rendering the factual account was delegated to them. Any success the Warwickshire Clean Air Council has enjoyed is due to the hard work of members too numerous to name, who have always been willing to shoulder the burdens thrust upon them. They will be content, as we shall be, if others think that this exercise in co-operation has been worthwhile.

APPENDIX

WARWICKSHIRE CLEAN AIR COUNCIL

CLEAN AIR ACT, 1956

INFORMATION REQUIRED AS TO TYPE OF PLANT TO BE INSTALLED FOR CONSIDERATION OF (*A*) HEIGHT OF CHIMNEYS (SECTION 10 CLEAN AIR ACT, 1956) AND (*B*) APPLICATION FOR PRIOR-APPROVAL OF PROPOSED PLANT

Name and address of premises where plant is to be installed................

1. STEAM GENERATION

Number and type of boiler(s) and name of manufacturer (*e.g.*) Horizontal, Cornish, Economic, Super Types, Vertical Multi-smoke Tube, Water-tube, etc.)

....

Maximum Working Pressure (lbs/sq. in.)

....

Maximum Evaporative Capacity (lbs steam/hour).........................

Dimensions of Boiler.................

Area of Firegrate...................

2. HOT WATER BOILER

Number and Type of Boiler(s) and Name of Manufacturer.....................

Boiler Rating (B.T.Us/hour)............

Dimensions of Boiler..................

Area of Firegrate...................

3. INDUSTRIAL PROCESS FURNACE

The variety of types of industrial process furnaces, *i.e.* furnaces other than furnaces of boilers, is very wide. Individual applications will therefore be considered on their merits and in relation to the fuel which is intended to be used, the equipment provided, and the purpose for which the furnace is to be employed.

State details of installation............

4. FUEL (Coal, Coke, Oil, Pulverized Fuel)

(i) *Coal*

(*a*) Is applicant satisfied that the size and grade are in accordance with the manufacturer's recommendations for the plant............

(*b*) Has applicant satisfied himself from the National Coal Board or other suppliers that reasonable continuity of supply of suitable fuel can be expected............

(ii) *Coke*

(iii) *Other Fuels*

(*a*) Nature ....

(*b*) Trade Wastes ....

(*c*) Approximate Analysis ....

(iv) *Liquid Fuels*

(*a*) Trade description with particular reference to viscosity in accordance with British Standard Specifications ....

Redwood Scale No.:..........

Specific Gravity:..............

Average hourly consumption based on 24 hours of heaviest envisaged load ....

5. METHOD OF FIRING (Hand, Mechanical, Underfeed Sprinkler, Coking, Chaingrate, Other)

(*a*) Hand-fired ....

Number of stokers full- or part-time.. ....

(*b*) Mechanical Stoker

Type:.......................

Manufacturer:................

Rating (B.t.us./hour)..........

Maximum Coal Feed (lbs/hour)

....

(*c*) Oil-fired. Manufacturer of Oil-burning equipment (fully automatic, semi-automatic, hand-controlled) ....

(*d*) Flame Failure Device..........

6. DRAUGHT PRODUCTION

(Natural, Forced or Induced with Fans or Steam Jets, etc.)

....

7. GRIT ARRESTER

Type and Manufacturer, Efficiency Factor Claimed ....

8. WATER FEED

. . . .

9. CHIMNEY (Height above Ground Level, Internal Dimensions and Construction)

. . . .

10. SMOKE INDICATOR

(a) Is chimney visible from firing floor? . . . .

(b) Is smoke density indicator/alarm/recorder provided? . . . .
Manufacturer . . . .

11. INSTRUMENTATION

Draught Gauges . . . .
Temperature Indicators/Recorders . . . . . .
Flue Gas Analysis—CO_2 Indicator/Recorder . . . .
Other Recorder or Indicator . . . .

The information on this form is submitted to the Chief Public Health Inspector of ———— Council as:

NOTIFICATION

(i) notification of the proposal to install a furnace in accordance with the provisions of Section 3 (3) of the Clean Air Act, 1956.

CHIMNEY HEIGHT

(ii) relevant data to enable the Local Authority to determine whether or not it is satisfied that the height of the chimney will be sufficient to prevent, so far as practicable, the smoke, grit, dust or gases from becoming prejudicial to health or a nuisance, having regard to:

(a) the purpose of the chimney;

(b) the position and description of buildings thereto;

(c) the levels of the neighbouring ground; and

(d) any other matters requiring consideration in the circumstances.

*PRIOR APPROVAL OF FURNACE

(iii) an application for prior approval of the furnace in accordance with the provisions of Section 3 (2) of the Clean Air Act, 1956.

* Delete if prior approval is not required

Signature . . . .
Position . . . .
Date . . . .

Discussion

R. A. Hacking, in opening the "Industry and the Clean Air Act" Session discussion said:

To open the discussion is a special privilege and pleasure to me, since my close contact and concern with the problems of my own industry—iron and steel—goes back to the formation of The Air and River Pollution Committee of the B.I.S.F. in the early 1950's. The experiences of a large group in another basic industry, and an advisory Council in one of our most important county areas compare and correlate with those of my own industry in a most interesting and intriguing way.

I am quite sure I voice the feelings of all of you in expressing sincere thanks and appreciation to the authors of these two interesting and comprehensive papers. To my mind, the outstanding point deriving from both papers and from my own experiences, is the progress achieved by frank discussion and the pooling of knowledge by the supervising body on the one hand, and industry on the other. A year ago at Harrogate, Dr. J. S. Carter named the iron and steel industry as presenting the most difficult of all the chemical engineering problems. The fact that solutions have been found to most of these, derives largely from the close co-operation of the Chief Alkali Inspector, his deputies and regional inspectors, in combing the literature and augmenting it with practical data on a world-wide basis, so that it could be applied at the earliest possible date and in the most effective manner, to clean up our emissions.

As a hard-headed Yorkshireman, Dr. Carter is keen on value for money; although the rose I am entitled to wear is red and not white, I assure you that goes for me too! The best possible result in terms of a consistently high level of freedom from pollutants for a given expenditure is obviously what we all want.

Mr. Britten's reference to his lime kiln problem reminds me how lucky we are in integrated iron and steel works, to have available for this purpose, mixed blast furnace and coke oven gas. Besides avoiding smoke difficulties, gas-fired kilns produce lime characteristically low in sulphur—an important advantage in steelmaking, especially for hot and cold strip-wise production of sheets and tinplate.

The author rightly stresses the technical difficulties and high capital and operating costs of SO_2 removal from flue gases, and its inapplicability at the moment to all but the largest and most concentrated sources. In our case also, resort to tall chimneys, of a height calculated from their mass emission of SO_2, is the policy laid down by the Chief Alkali Inspector, and this is particularly important in the case of sinter plants, open hearth furnaces, etc. But I would like to draw attention to the blast furnace, unique among users of carbonaceous fuels, in that of all the sulphur charged into the system, well over 90 per cent is "fixed" in the slag, a little in the metal, and only a very few per cent emitted to atmosphere, mostly within the cast house during flushing and casting.

Even in the case of "acid burdening", where the alumina content of the slag is in a difficult range which compels some forfeiture of its normal desulphurizing function, the foregoing statement is still true, the partition of sulphur being more towards the metal, but not to atmosphere. Unfortunately, the strongly-reducing conditions which cause the blast furnace to act in this commendable way, are not applicable to the general problem.

In the Warwickshire Clean Air Council paper, I am not surprised to note the difference of opinion in regard to the value of deposit gauges. My own Company has been running quite a number co-operatively with local authorities for many years, and in addition to the faults and provisos enumerated in the paper, I would add the influence of rainfall, by amount and type, and neighbouring topography, on the pattern produced. The deposition contour map compiled by H. G. Jones (I. & C.T.R., 1955, 170, April 15, pp. 839-845) for the Steel Company of Wales Abbey Works, graphically illustrated the effects of these factors. If these are borne in mind I think that deposit gauge results can be worthwhile.

In regard to fluorine emission, metallurgical industries are not the only, and indeed not even the main source, but in iron and steel we are pleased to report several favourable trends. Iron ore calcination, whether in clamps or in kilns, is fast decreasing. In its place, the growing use of self—or super—fluxed sinter fixes nearly all the fluorine in the material charged into the blastfurnace, in which process it is combined in the slag or removed in the gas cleaning equipment. In steel furnaces using oxygen, the fume arrestment plant should largely entrap any fluorine existing in particulate form.

As Dr. Carter pointed out a year ago, the Clean Air Act reached the Statute Book at a time of intense technical change in the steel industry. He was referring of course to the advent of the new oxygen processes, notably the LD, LDAC, Kaldo, Rotor and Ajax. All such British installations came into the category of "new plant" so far as clean air was concerned, and all are or will be fitted with high efficiency cleaning equipment, with dry electrostatic or venturi scrubber emerging as the "preferred" types. How to cool the emergent gases is a matter of some controversy, and in some recent installations, the waste heat boiler characteristic of the original Austrian plants has given way to the direct cooling developed by the Americans. A still later development (in France, Japan and Germany), is the preservation of the fuel value of the CO-rich gases by exclusion of air by mechanical and/or gas pressure sealing of the junction between converter nose and hood. By thus keeping gas temperatures and volumes down to a minimum, the capital and operating costs of the cleaning plant are greatly reduced, and a valuable fuel obtained for steady use via gas holder and distribution mains in other departments of integrated steelworks.

Electric arc furnaces using oxygen posed another major problem in regard to effective containment whilst avoiding explosion hazards from CO-rich gas evolved during lancing of the bath. Here again we acknowledge the substantial help given by Dr. Carter and his colleagues to the Working Party, whose report incorporating recommendations on plant and practice was circulated to industry some months ago.

Time does not permit me to go into further detail, but all interested in the technical aspects are referred to the papers by Wood, Cooper and Graham, Shaw and Dr. J. S. Carter at last year's Conference at Harrogate. Developments and operating experiences meantime will be described and discussed at the Autumn General Meeting of the Iron and Steel Institute, where the main event is a two-day Conference to be held at Church House, Westminster, on November 26 and 27, on the subject of "Fume Arrestment in Steelmaking Processes". A total of 14 papers will be presented by authors from the United Kingdom, Austria, France, Germany and Japan, during four sessions devoted to general principles, and to operating experiences in open hearth, basic oxygen, and electric arc steelmaking respectively. Members of this Clean Air Conference are cordially invited to attend.

Mr. Britten quotes for the Alkali Division of I.C.I., an expenditure on investigatory work and installations for the reduction of atmospheric pollution of £2 million to date, with a further £0·75 million in prospect—a total of £2·75 million. This correlates with the expenditure at Spencer Works to date of £3·3 million, on the measures described in the Winter 1962 issue of *Smokeless Air*.

By far the largest item was the LD steel plant boilers, venturi scrubbers, sludge thickeners, vacuum filters, etc., which accounted for two-thirds of the total. Next came the £550,000 expended on electrostatic precipitators, cyclones, etc., at the sinter plant. Double collecting mains, grit arresters, etc., at the coke ovens cost £250,000; dust extraction equipment at raw materials reception and handling stations and boiler plant cost £220,000. Fume extraction at the hot scarfer in the primary mill cost £82,000.

No expenditure was involved on replacement of steam locomotives by diesels, since Spencer Works naturally adopted the latter at the outset. In the case of our Ebbw Vale Works however, the 20 diesels acquired to date have cost £467,000, with four more required to complete replacement of the original fleet of 38 steamers. Other major expenditures on clean air measures at Ebbw Vale are £900,000 at the LD steel plant—incidentally the first in the U.K.; £123,000 on electrostatic precipitators at the H.P. boiler plant—during the years 1946 to 1951 in pursuance of a "good neighbour" policy. By the time we are able to say, hand on heart, that the best practicable means have been applied in every instance, the total at Ebbw Vale will be over £1·6 million.

These figures are I think typical of the sort of monies involved in the case of "new" and "existing" works respectively. They will of course vary according to the size and capacity of the plant, and the practice adopted, especially in the steelmaking section. It should be remembered also that during the same period of time, most iron and steel works were involved in expenditure of the same order of magnitude, on measures to meet statutory requirements in connection with liquid effluents.

The figures quoted do not of course include expenditures on coke-oven and blast-furnace gas cleaning, which in the interests of technical efficiency and economic return, we have been doing to very high standards of cleanliness for several decades. The contribution of such measures to clean air, whilst incidental, is substantial and extremely important.

Several problems remain to be solved—notably that of getting the iron oxide dust or sludge removed from steelplant emissions, usefully back into the system in the most convenient and efficient way. At least one problem—that of the bottom-blown converter—seems incapable of solution, but use of this process in the U.K. is fast diminishing.

R. Hussey (Elliott Automation) spoke as both a delegate and an exhibitor. He had listened to a most interesting paper by the joint authors, Messrs. Allen, Calvert and Crow, and would say as a delegate that the paper sets an excellent example to clean air councils to fully appreciate the task set by the Clean Air Act coupled with the requirements of the Alkali Inspectorate.

As an exhibitor however, he would crave some licence therefore on commercialism and would point out that other types of dust meters were available to that referred to which were suitable not only for both pulverized fuel and stoker-fired boilers in power stations but also other industrial chimney effluents. The Konitest shown by Elliott Automation was capable of calibration whilst in use and presented the simplest form of continuous mechanical dust meter available suitable for power stations, steel works, cement works, etc.

A portable form was now available for the testing of the efficiency of dust collecting plant and this was further developed by the South Thames Division of the South Eastern Region Test and Efficiency Department of the Central Electricity Generating Board, to whom they acknowledged their thanks.

With regard to the paper presented by Mr. A. N. Britten, he was interested in the "new system" of automatic boiler control devised by the Alkali Division at Northwich as distinct from the original "Air-fuel ratio system" installed. Could further details be given, as the "Air-fuel ratio system" was well known already but perhaps the refinements to the system referred to were worthy of better mention.

He posed a second question with regard to dust and grit emission which were stated to be:

Chain grate boilers	—about 0·01 tons/ton fuel
P.F. Boiler	—about 0·13 tons/ton fuel

It would be appreciated if the emission could be stated in terms of grains/cubic foot in view of the understanding which appears to exist between industry and the Alkali Inspectorate that 0·3 grains/cubic foot should not be exceeded by more than 0·03 grains/cubic foot larger than 76 microns (equivalent mesh BS. sieve 200). The effective collection of particles larger than 76 microns, and more particularly those larger than 150 microns, was most important and reported to be related to industrial factory boiler plant exceeding 35,000 lbs./steam/hour.

H. E. T. Lowbridge (Willenhall) said he had been impressed by the account of activities on the Warwickshire Clean Air Council.

After consideration of the objects and the constitution of the Warwickshire Clean Air Council and of the Midlands Joint Advisory Clean Air Council, he felt that there was a need for *co-operation* and *consultation* between the various clean air councils which operate in different parts of the country.

These Joint Advisory Councils consisted of local authority elected representatives and officials.

In the respect that these Advisory Clean Air Councils were confined to local authorities they differed from the National Society for Clean Air, which catered for not only local authorities but nationalized and private industry. However they were, he thought, all ardent supporters of the National Society for Clean Air.

Local authorities were charged with the administration of the Clean Air Act and there were many difficulties to be overcome by co-operation and consultation between local authorities. If this was the case then it had to be accepted that a case existed for co-ordination and co-operation between the various Joint Advisory Clean Air Councils.

Mr. Sugden had referred in his paper to the recent agreement which was reached on cold blast cupolas between the Council of Ironfoundry Associations and the Midland Joint Advisory Clean Air Council. Mr. Lowbridge suggested that this agreement be considered and possibly accepted by other Joint Advisory Councils.

F. F. Ross (C.E.G.B.) referred to a point made in the discussion that even the small proportion of fine dust which escaped electrostatic precipitators had to come down somewhere. He supposed this was true, but if it came down eventually in Australia, was that important? The Warwickshire paper had referred to the A.E.I. Dust Monitor and all that was said in its favour appeared to be true. There were other instruments, however, and a fair assessment of their advantages and drawbacks had been published in the *Electrical Times* of March 14, 1963.

Councillor J. Sanders (Atherstone R.D.C.) spoke of the cost of air pollution to the nation. He criticized the Government for failing to support more realistically the National Society in their aims for cleaner air.

Continuing, he said that at the present rate of progress the recurring cost of air pollution could be £3,000 million in 10 years time.

This, he said, should be arrested by increasing grant aid to local authorities and by subsidizing the production of greater quantities of suitable solid smokeless fuel.

He agreed with Dr. Mary Catterall the author of an earlier paper who had said that an intelligent overall national fuel policy was required and the guts to see that it was carried through.

He urged Conference to tell the appropriate Ministries to pursue their objective of clean air with greater vigour.

C. H. Crawford (Brierley Hill) said it was clear that industry had spent and intended to spend large sums of money in order to satisfy the Clean Air Act, and that it was only a matter of time before the very difficult problems of some of the scheduled processes would be overcome. It would be very interesting to obtain an estimate of the amount of money industry had spent and compare it with the amount of money spent by local authorities on Clean Air Act grants. He was sure that the industrial figure would be larger. It appeared to him that local authorities were waiting for industry to complete this work before commencing their own work. If they persisted in this, they would find that in a few years when industry had been cleaned up, local authorities still had fifteen to twenty years work to do. They must, therefore, get on with the job now.

Regarding the supplies of solid smokeless fuels, he was sure that shortages related principally to supplies of premium fuels. So far as he himself was concerned, gas coke was perfectly satisfactory and cheaper to use. He understood that gas coke was being exported to Scandinavia. Surely this could be sent to the North East of England if there was a shortage there.

F. E. Ireland (Alkali Inspectorate) explained the Alkali Inspectorate's approach to air pollution problems. Naturally they had to have due regard to the effect that the more toxic materials might have on the health of the public, but their attitude was that any pollution of the air was bad and anti-social and they aimed at reduction of all forms of pollution under their control to the practicable minimum; in some cases this meant complete elimination. No complicated reasons such as proof of a health hazard were needed as an excuse for preventing pollution of the air. It was extremely difficult to prove that the usual air pollutants in concentrations experienced in this country, even under adverse conditions, were a health hazard. Anyone could see with half an eye that pollution was undesirable and should be reduced as much as possible.

E. B. Briggs (Shell-Mex and B.P.) said that in the Warwickshire Clean Air Council's paper there was reference to the work carried out between his Company, Shell-Mex and B.P. Ltd., and Mr. Ronnie Williams, then of Coventry, with regard to the determination of chimney heights to meet Section 10 of the Clean Air Act. This was eventually published by his Company as a chart, which was probably well-known to many delegates. It used sulphur dioxide as a tracer for determining chimney heights. He wished to stress that his Company had now withdrawn that chart and he submitted it with very good reason. The introduction to the chart was worded: "this provisional chart is put forward until such time as official guidance becomes available" and it was considered that when the Ministry had put out their recent Memorandum on Chimney Heights, it was the time to withdraw the Company's chart. This had been done and now Shell-Mex and B.P. fully endorsed the Ministry's Memorandum. Reprints of Mr. F. E. Ireland's paper, which gave the technical background leading up to that particular Memorandum, were available at the Company's stand and delegates were asked to go along to discuss the matter, and at least to help themselves to a copy of Mr. Ireland's paper.

Mr. Briggs' second point concerned the reference Mr. Calvert had made to the low sulphur fuel now available to Coventry Corporation. He had been at last year's Conference at Harrogate and heard Dr. Carter state the position then with regard to the availability of low sulphur oils, and it should be stressed that the position certainly had not changed. So far as residual fuel oil grades were concerned these were available only if crude oil with low sulphur content was available and speaking in the most general terms for the whole country the position was exactly as Dr. Carter had stated last year. There was as yet no means of reducing the sulphur content of residual grades of fuel oils at the refineries; the cost was entirely prohibitive and it was commercially impracticable to pass on the cost to the eventual user. Whatever happened in the long run to the availability of the low sulphur oil in the residual grades (they referred to 220 seconds and 950 seconds oil), if someone in the country increased their consumption markedly this would inevitably be at the expense of someone else.

J. W. Butler (Individual Member) said that he thought they all had to be very grateful to Mr. Calvert for having covered rather more ground by his spoken word than in the written contribution on the work of the Warwickshire Clean Air Council. He was himself associated with one of the industries which Mr. Calvert had mentioned as offenders in the Warwickshire District, and welcomed his explanation of the special problems in particular industries. The written contribution was a very noncommittal, colourless and highly compressed account of the problems of industry and of administrating the industrial provisions. There was some emphasis on section 10 relating to chimneys and also to section 3 about smokelessness, but the particular matter of grit and dust had been passed over in a very glib sort of way. Mr. Calvert had spoken especially of small iron foundries in the County of Warwickshire and something had been heard that afternoon of the Goliaths in the world of industry, of what I.C.I. had been able to do with their massive financial resources, and also what some of the larger steel companies had done on the quite impressive scale of expenditure. When one considered the smaller establishments, one had to recognize that ways and means of coping more efficiently with grit and dust problems were known but one came up against the brickwall of what was financially reasonably practicable. He thought the reference to the research association of the iron founding industry was unfair, and would like to assure Mr. Calvert that from what he knew of the work of the Association, its ideas did not need brightening up; it knew very well what needed to be done to suppress grit and dust more efficiently than at present but it was beyond the financial resources of some of the small units in the county to make the necessary installations.

P. H. G. Grimmett (Wednesfield) said that as the discussion had proceeded he felt that the first paper was not receiving much attention and as the Author might feel he was getting away with it, he would like to take one or two points made in his introductory comments.

He referred to the immense strides that had been made by industry in cleaning the atmosphere and appealed to them not to rest upon their laurels. Mr. Britten had told the Conference that "£10,000 was a lot of money". To accept this depended on ones sense of values.

Mr. Grimmett paid tribute to the excellent paper by Dr. Mary Catterall with its emphasis on the value of human life and the effect that pollution had upon people. If a car knocked a person down there was legal redress but if as a result of atmospheric pollution a person was subject to chronic illness and a slow, lingering death there was no redress. Surely their sense of values needed to be modified. He agreed that investors should get a fair return on their money but industry should not strive to increase the percentage of dividend annually at the expense of requisite works for the benefit of the community at large. The tragedy of the present day was the power exercised by some accountants who could see only profit and loss on a piece of paper. This limited approach was bringing about the increasing concentration of industry and even local government reorganization. The value of the individual and his needs were being overlooked. They must re-examine their sense of values as far as human life was concerned.

Referring to the Warwickshire Clean Air Council paper, Mr. Grimmett asked the following questions:

(1) Who met the cost of instruments and appliances required?

(2) How much did the scheme cost the constituent authorities?

(3) As some authorities had failed to co-operate in the national scheme of the Co-operating Bodies and D.S.I.R., could they know if all authorities in Warwick County were in the scheme, and if so, could they give any hints to D.S.I.R., in the matter of such persuasion?

(4) How much did Warwick County Council contribute?

Author's Replies

Mr. Britten, replying to the discussion said he welcomed Mr. Hacking's confirmation of the value of frank discussion with the supervising body and wished to reaffirm his own belief in the value of such discussion, provided it was in fact frank. Such discussions were particularly valuable when dealing with lay bodies that were perhaps not as well qualified as the Alkali Inspectorate; for example, to appreciate the nature and full significance of the technical problems facing a particular industry, and what in fact constituted a practicable solution to a problem.

He also welcomed Mr. Hacking's support for the thesis that while atmospheric pollution was a serious social problem, limitless expenditure could not be justified; industry's problem, in conjunction with responsible supervising bodies, as Mr. Hacking confirmed, was to obtain the maximum benefit from the minimum expenditure.

Replying to Mr. Hussey, he said that full details of the automatic control system for chain grate stoker boilers were given in papers published in the *Journal of the Institute of Fuel*, Vol. XXXIII, No. 239 (December, 1960) and Vol. XXXIV, No. 242 (March, 1961).

The grit and dust emissions from boilers in grams/ft^3 corresponding to those quoted in the paper were:

Chain grate boilers—about 0·01 tons,

ton fuel—0·334 grams/ft^3 at N.T.P.
PF boiler—about 0·13 tons/ton fuel—
4·16 grams/ft^3 at N.T.P.

In reply to Councillor Sanders, Mr. Britten agreed that the contribution made by domestic premises to atmospheric pollution sometimes appeared not to be given due consideration, particularly if it existed alongside industrial pollution. In his own experience, when making a survey of ground pollution around a large factory, ground level SO_2 concentration that clearly originated from domestic chimneys (that is, the wind was blowing *towards* the factory) had been found to be far higher than any found when SO_2 was being blown from the factory to the same site.

He did not agree with Mr. Grimmett's views on the attitude of industrialists toward the spending of capital on measures to reduce atmospheric pollution. Industrial managements had a duty toward their shareholders to ensure that the invested capital was employed as profitably as possible. Management had, therefore, to ensure that capital spent on reducing atmospheric pollution (capital that was usually completely unprofitable) was the minimum consistent with its statutory obligations. And it should not be forgotten that the investing of unjustifiable large sums of capital on reducing atmospheric pollution was not only a burden to the company concerned, but was a drain on the national economy. For example, deaths caused by motor vehicles could be completely prevented by abolishing road vehicles, but the cost of doing so would be unacceptable. Similarly, deaths and ill health from air pollution could virtually be prevented by stopping burning fuel, but again such a solution would be clearly absurd. There was obviously an economic optimum somewhere.

Whatever standard of values Mr. Grimmett adopted, £10,000 *was* a lot of money, and was worth precisely as much to a large Company like I.C.I. (and possibly more) as to anyone else.

B. D. Allen, in answering part of the discussion on the Warwickshire Clean Air Council, said in reply to Councillor Sanders that there was need not only for a smokeless fuel production policy, but also need for a fuel distribution policy. Something required doing urgently. One often heard the cry that there was a grave shortage of suitable smokeless fuels. No definition was ever given of the word suitable, but invariably the cry related to premium fuels only. Shortages of gas coke were only regional problems. For instance, in the West Midlands they had ample fuel, yet they continually heard the cry concerning this supposed shortage of suitable solid smokeless fuel.

In replying to Mr. Hacking and Mr. Butler, he said that frank discussions and exchange of knowledge were vital. So, also, was co-operation, and he would remind the Conference that co-operation, like courting, required two to take part. Industry should consider that it has a duty as a good neighbour, and should not merely count the cost of clean air as a commercial transaction. Some sections of industry had done great work. Some sections, to say the least (and particularly some ironfounders), were dragging their feet. One could agree in part with Mr. Butler on the economic problem, but it should be pointed out that in the Warwickshire Clean Air Council they believed that uniformity of application of Clean Air Act provisions can even out competition factors.

To Mr. Briggs of Shell-Mex, Mr. Allen said that in relation to the chart on chimney heights which had been mentioned, it could still be used for small installations. He would advise that in relation to fuel oils, low sulphur content oils should be directed to plants with low chimneys. Oils with high sulphur content should be for installations with high chimneys which could disperse the gases without increasing ground level concentrations of sulphur.

R. K. Crow in replying to the discussion said Mr. Hussey's contribution was welcomed because the type of dust monitor which he produced was like the A.E.I. one, precisely the kind of instrument which was required in the interests of public health. Both provided continuous monitoring of the flue dust burden 24 hours a day and both measured the finer particles. Large particles were of local importance only. They quickly fell to the ground near the plant. Fine material remained suspended and provided the nuclei on which smoke fogs were formed.

He agreed with Mr. Ross that there were other instruments and that the *Electrical Times* of March 14, 1963, gave a fair assessment of these instruments.

The A.E.I. monitor was referred to in this paper because it was the result of research done at A.E.I. Research Laboratory, Rugby, and reported to the Warwickshire Clean Air Council by Dr. Grindell in October 1961.

In reply to his questions 1 and 2, he would refer Mr. Grimmett to the last paragraph of Item One of the paper where the system of financing the organization was referred to. The cost of instruments was, of course, met by the Warwickshire Clean Air Council and the cost varied from year to year. He would supply Mr. Grimmett with last year's costs.

In replying to question 3, all the authorities in Warwickshire (except Birmingham) were members of the Warwickshire Clean Air Council and all members co-operated in looking after Warwickshire Clean Air Council instruments. A large number of these instruments were included in the National Survey and there had been no difficulty in siting these in the desired areas. The Warwickshire Clean Air Council was a member of the Co-operating Bodies of the Department of Scientific and Industrial Research and sent delegates. Warwickshire County Council having no duties under the Clean Air Act had no direct interest in membership. It was therefore all the more pleasing that Warwickshire County Council was a member, and gave active support to the organization. Although under no financial obligation at all a contribution of £100 per annum was made.

Finally, he would say to Mr. Hacking that impressed as they had been by the efforts that some industrialists were making in the interests of clean air there could be no grounds for complacency. It was undoubtedly true that the prevention of pollution was an oncost to industry. Expenditure under this head brought no commercial return. Industry was therefore entitled to demand uniformity of enforcement by the Alkali Inspectorate and by local authorities. The co-operative industrialist must not be penalized because he co-operated while his competitor was allowed to "get away with it". Conditions of competition would still be equal given uniformity of enforcement if legislation were made stronger.

The role of this Society, he submitted, should be to continue its battle for stronger legislation and higher standards.

AN EXPERIMENTAL CHIMNEY FOR THE STUDY OF DISPERSION OF GASEOUS POLLUTANTS

by

*L. E. Reed, M.Sc., Ph.D. A.M.I.Mech.E.; C. F. Barrett, M.Sc., and S. C. Wallin**

SUMMARY

An experimental chimney, has been constructed at Warren Spring Laboratory for use in the study of dispersion of chimney gas. Experiments to correlate wind-tunnel tests on a model with full-scale tests are being conducted but no conclusions have yet been reached. A simple method of calculating the concentration produced by the plume from a chimney impinging on a nearby building is given and some calculated results are compared with observed concentrations.

THE degree of air pollution that exists in our towns and cities is a balance between the volume of pollutants emitted and the natural dispersive power of the atmosphere. As the standard of living increases, fuel consumption, and hence the quantity of pollutants emitted, shows a corresponding increase; at the same time there is a greater demand for cleaner air. It is therefore easy to see why the design of chimneys has become of increasing importance. Many papers have been written recommending a particular height of chimney for a given quantity of pollutant discharged, but until recently there has been no official guidance. A memorandum[1] has now been issued by the Ministry of Housing and Local Government based upon the findings of a working party set up by Warren Spring Laboratory. The discussions of the working party, reinforced by representations from the Federation of British Industries, made it very clear that there are important gaps in our knowledge, and the aim of the investigation described in this paper is to fill in some of these gaps.

From an air pollution point of view the principal requirement of the design of a chimney is to ensure that the pollutant emitted is diluted to an acceptable concentration at points where it might cause trouble. The dispersion of pollution from an isolated chimney over flat ground is fairly well understood; in such cases Sutton's formula and similar well known formulae are applicable. When the air flow is disturbed by large obstructions, such as buildings, there is less certainty.

The effect of a building on a plume emitted near to it is, in general, that the plume tends to be drawn downwards behind the building, a phenomenon known as "downdraught". According to a widely accepted rule-of-thumb—the "2½ times rule"—the effect of downdraught can be avoided if the chimney is made 2½ times as high as the building. The rule is a

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* Warren Spring Laboratory

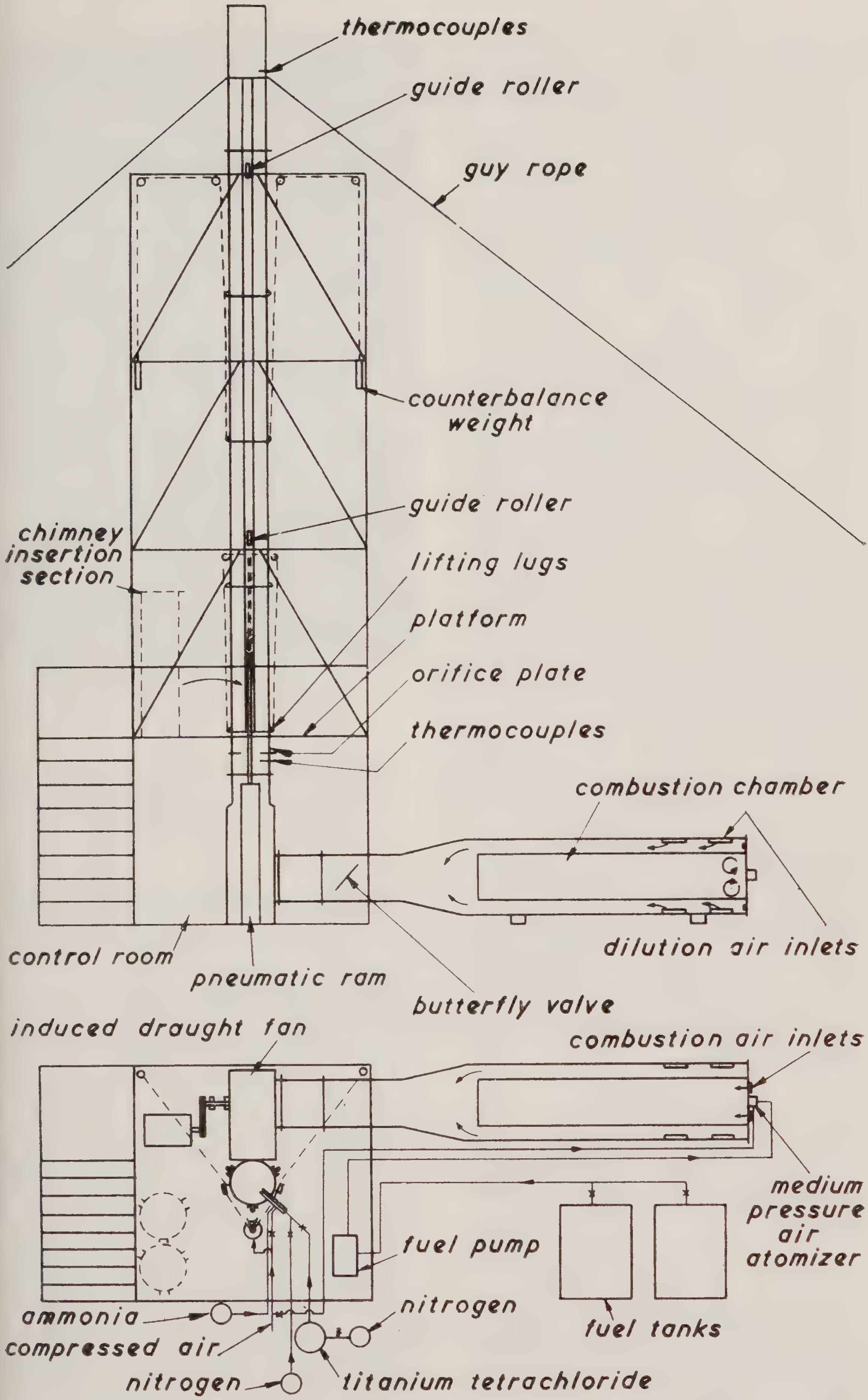

Fig.I. Diagrammatic arrangement of experimental chimney

good guide if used with discretion, but if applied generally many chimneys would be absurdly high, because to achieve sufficient dilution of the effluent it is not usually necessary to avoid the influence of the building altogether. A modified form of the $2\frac{1}{2}$ times rule which is applicable to single rectangular buildings, and takes account of the shape of the building, is contained in the memorandum already referred to.

In more complicated cases, for example, in the installation of central heating plant in a large office block, or the erection of a chimney in an area with a number of large buildings, tests on a model in a wind tunnel are often used. Although such tests have been in use for some thirty years, there does not seem to have been any thorough study of the adequacy with which the behaviour of the prototype can be thus represented; such a study is the principal aim of the experiment described in this paper which is being carried out in collaboration with the National Physical Laboratory. An experimental chimney has been constructed near the Warren Spring Laboratory buildings and dispersion of the plume from this chimney is being compared with that of a model in a wind tunnel at the National Physical Laboratory.

In addition to this work, studies are being made at Warren Spring Laboratory of the effect of the chimney itself on the plume ("downwash"), and of the effect of a plume on a nearby building.

General Considerations

In experiments of this sort it is impossible to achieve complete similarity between the model and the prototype, and it is necessary to concentrate on those features which appear to be important. In wind tunnel tests the model of the building is made to scale i.e. the linear dimensions have the same ratio in the model as in the prototype and the same ratio of efflux velocity to wind speed is preserved; this is the extent to which similarity is attained. It migh be thought necessary to keep th Reynolds numbers constant. A example will show that this is no possible; to represent the flow roun a building in a 20-m.p.h. wind using a 1 : 100 scale model would require a speed of 2000 m.p.h. in the tunnel This is greater than the speed o sound, and the flow pattern produce would be quite wrong. In fact the flow around an object with salient edge does not change appreciably as the Reynolds number is increased beyon a few thousand. This is relatively easy to achieve, except for small features o the building, possibly including the chimney itself. Other features of the flow likely to be important in the present case are:-

1. Turbulence—a normal win tunnel has a low level of turbulence compared with the atmosphere.
2. Buoyancy of the effluent—buoyant effects cannot be modelled accurately in a normal wind tunnel.
3. Thermal stability (given by the variations of temperature with height)—the wind tunnel is always in a state of neutral stability.

These considerations have determined the design of the experiment.

Experimental Equipment

The equipment used for the full-scale experiments consists essentially of a combustion system, a smoke-producing unit, and a chimney of variable height. (See Fig.1 and Plate 1). The diameter of the chimney is 2 ft. and the height can be varied in 4-ft. or 8-ft. increments from 40 to 92 ft. This is achieved by lifting the chimney from a point 11 ft. above the ground by means of a pneumatic ram and pulley system and inserting or removing a section. At the maximum height the chimney is 2·4 times the height of the surrounding buildings.

The flue gas can be emitted from the chimney at temperatures up to

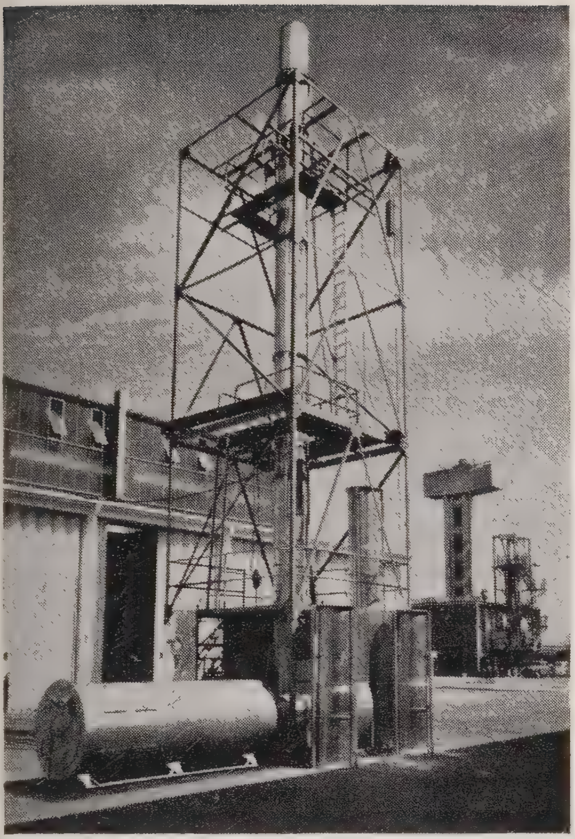

Plate 1. Experimental Chimney

260°C and at velocities up to 100 ft/s. The gas is heated in a refractory-lined combustion chamber using gas oil. To obtain the wide range of conditions required a turn-down ratio of 20 : 1 is necessary, and this is achieved by using two medium-pressure air-atomizing burners of different throughputs. The products of combustion are diluted by air introduced at the end of the combustion chamber and the cooled gas is delivered to the chimney by a 40-h.p. fan rated at 12000 ft^3/min. Gas temperatures at the top and bottom of the chimney are measured by means of thermocouples and the efflux velocity is calculated from the differential pressure registered across a calibrated orifice.

The dispersion of the gas from the chimney has been studied by photographing the plume from either one or two positions and analysing the resulting film. It was essential therefore to make the plume visible and several methods were tried:

(a) Combustion control. Dense black smoke was produced in the combustion chamber by restricting the quantity of combustion air, but after the introduction of the dilution air, opacity was not sufficiently persistent for photographic purposes.

(b) Vaporized gas oil. Gas oil was injected into a vaporizing pot downstream of the combustion chamber, but the danger of explosion caused this method to be abandoned.

(c) Smoke bombs. A persistent white plume was obtained by using commercial smoke bombs, but the method was too expensive.

(d) Titanium tetrachloride injection. The method described by Dunbar[2] and Smith was used and found to be satisfactory and has been used in most of the tests.

Wind speed and direction are measured by a standard Munro anemograph mounted at a height of 100 ft. on a mast in open ground near to the Laboratory. More recently, recording bidirectional vanes based on the design of Jones[3] and Butler, have been installed to measure turbulence, and a set of aspirated thermocouples has been added to measure the thermal stability.

For the wind-tunnel experiments a model of the Laboratory was made to a scale of $\frac{1}{8}$ in. to 1 ft. and is being used in the low-speed wind tunnel at N.P.L. The path of the plume from the model chimney is recorded photographically.

Experimental Observations

The chimney is sited at the position shown in the plan of the Warren Spring Laboratory in Fig. 2. The heights of the surrounding buildings are marked on this plan.

Plate 2 shows a typical experiment in progress. The test conditions were:

Height of chimney 64ft.
Wind Speed 13 knots (22 ft/s).
Efflux velocity 60 ft/s.
Gas temperature 200°C.

At the time of writing, insufficient comparisons between the wind-tunnel and full-scale observations have been made to enable any general conclusions to be reached on the validity of

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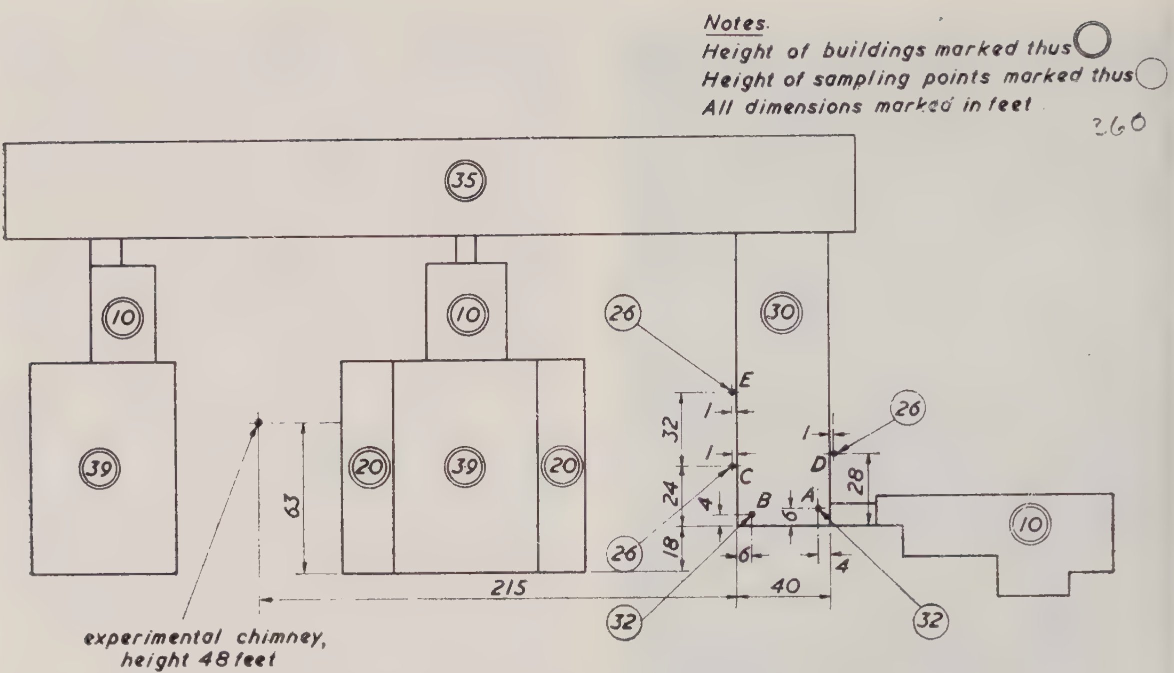
Notes.
Height of buildings marked thus ○
Height of sampling points marked thus ○
All dimensions marked in feet
35
10
10
26
30
E
32
1
24
1
C
4
B
6
A
D
1
28
26
10
39
20
39
20
63
215
40
18
26
6
4
32
32
experimental chimney, height 48 feet

Fig. 2 Plan of buildings and sampling positions

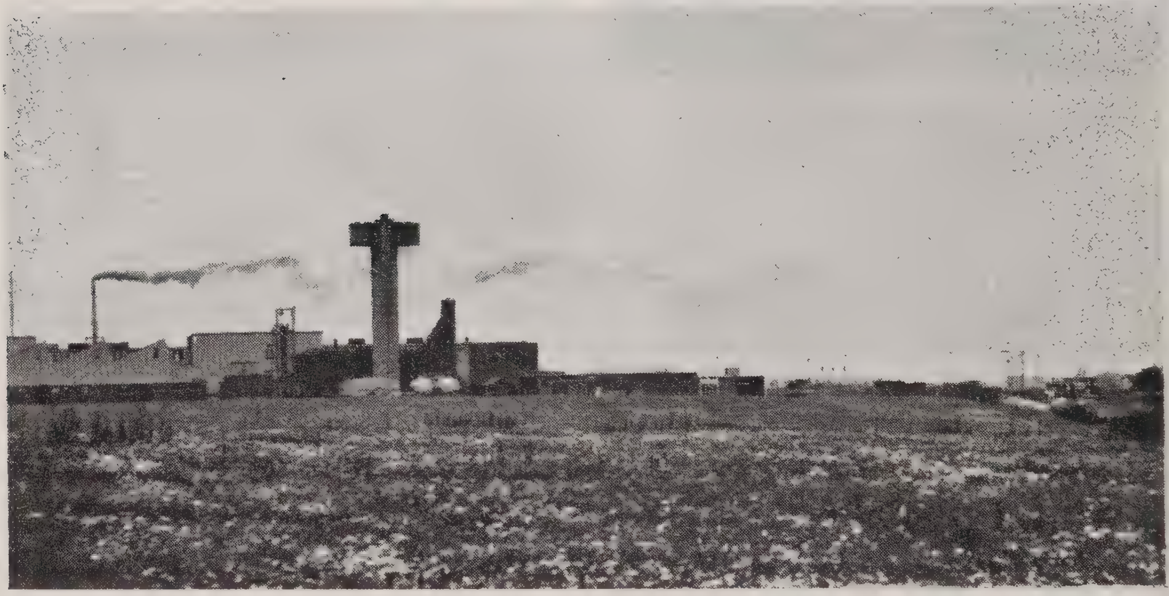

Plate 2. Smoke issuing from Experimental Chimney

wind-tunnel tests, but two other short-term investigations have been made.

Downwash

Downwash is the phenomenon that occurs when the plume is entrained in the wake behind the chimney itself. It reduces the effective height of the chimney and causes blackening of the chimney top. A chimney in a wind tunnel can give such severe downwash that the plume appears to be emerging from a row of holes on the downwind side of the chimney. This effect is very rare on full-scale chimneys and is due to the fact that the Reynolds Number of the model chimney is low and a larger wake is formed, this suggests that conclusions on downwash drawn from model experiments may not be valid.

A series of tests was made with the

experimental chimney at a height of 72 ft., the maximum available at the time, in an attempt to reduce the influence of the wake of the building. An anemometer was mounted near the top of the chimney so that local wind speeds could be determined. Cine films were taken with two cameras, one downwind of the chimney and the other at right angles to the plume. A range of efflux velocities was covered. A typical photograph from this series is shown in Plate 3, where the ratio of efflux velocity to wind speed was 0·7.

Downwash was found to occur only when the efflux velocity was less than the wind speed. This is less restrictive than the figure of 1·5 for the ratio of efflux velocity to wind speed, quoted by G. Nonhebel[4] and based on wind tunnel tests at I.C.I. but it agrees with a statement by Scorer[5]. Tests are being continued.

Concentration of Pollutant near to the Chimney

The concentration of a pollutant received at ground level is normally the important factor, but there are many cases in which a higher concentration may be received where the plume impinges on a nearby building. No measurements of concentration in these circumstances are known to the authors; the only data available are those given by J. Halitsky[6] based on measurements on a model in a wind tunnel.

One simple method of obtaining a rough estimate of the concentration received is to assume that the plume diverges uniformly in the shape of a cone of half-angle 12° with the chimney as the apex. This method is suggested by Scorer[7] and Barrett and it leads to an equation which can be expressed with sufficient accuracy as:

$$C = 25Q/\pi UL^2 \quad .. \quad .. \quad (1)$$

where C is the concentration of pollutant received

Q is the mass of pollutant emitted per unit time

U is the wind speed

L is the length of the path of the plume.

Halitsky gives the equation (in slightly different notation)

$$D = 2{\cdot}22M\,(3{\cdot}16 + 0{\cdot}1R)^2\,U/V \quad .. \quad .. \quad (2)$$

where D is dilution ratio, $\dfrac{\text{concentration in chimney}}{\text{maximum concentration in plume}}$

U is wind speed.

V is efflux velocity

R is $\dfrac{\text{length of path of plume}}{\sqrt{\text{Area of chimney}}} = \dfrac{L}{\sqrt{A}}$

M is a coefficient which is said to take account of variation of turbulence along the path of the plume; it can apparently take values between 1 and 50.

If the mean concentration in the plume is one third of the maximum as assumed by Halitsky, then we can derive a similar equation to (1)

$$C = Q/6{\cdot}66MU\,(3{\cdot}16\sqrt{A} + 0{\cdot}1L)^2 \quad .. \quad .. \quad (3)$$

Although this equation is different in form, it can be made to give the same result as Eq. (1) for any values of A and L by assigning a value to M. This appears to be permissible because M can only be derived from experience, although it is stated by Halitsky that it should not normally exceed 7. In the present experiment, with a chimney diameter of 2ft. and L=200 ft. Eq. (3) will give the same result as Eq. (1) if M=1·15.

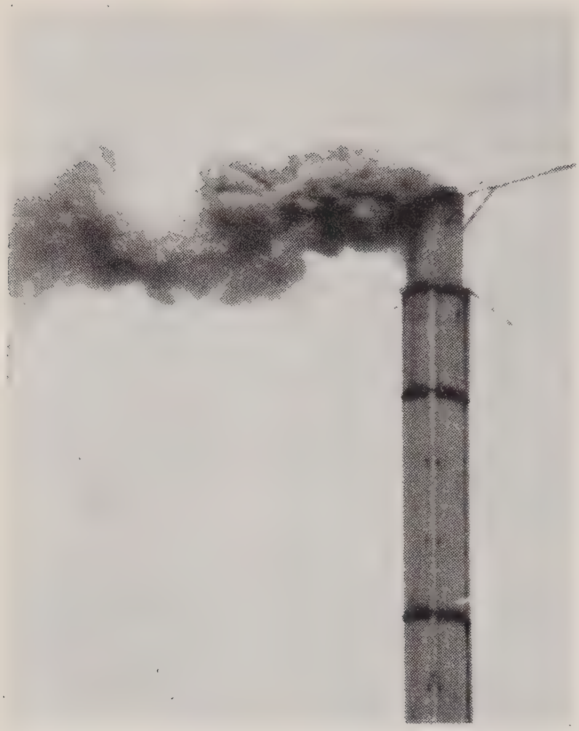

Plate 3.
Chimney Exhibiting Downwash

Although both equations will give the same result and Eq. (1) would seem to be preferable because of its simplicity, on most occasions the plume will only impinge intermittently on a building and the introduction of some factor similar to M may improve the estimate of concentration at a given point.

Concentration measurements were made at various points on a building near the experimental chimney. Carbon disulphide was added to the fuel so that the sulphur dioxide content of the flue gas was increased to give an emission comparable with, for example burning 270 lb/h of fuel oil. The concentration of sulphur dioxide was measured at five points by recorders of the type described by Nash[8]. The five measuring points are indicated in Fig. 2. Points A and B were on the roof and points C, D, & E were just outside the open windows of the offices on the top floor.

Table 1 gives some of the observed concentrations together with values calculated from equation (1) with the assumption that the wind impinges on each point for the whole of the

TABLE 1.—FIVE-MINUTE MEAN CONCENTRATIONS OF SULPHUR DIOXIDE

SO_2 Emission g/sec.	Wind Speed Knots	Point A, $\mu g/m^3$		Point B, $\mu g/m^3$		Point C, $\mu g/m^3$		Point D, $\mu g/m^3$		Point E, $\mu g/m^3$	
		Observed	Calculated	Observed	Calculated	Observed	Calculated	Observed	Calculated	Observed	Calculated
1·94	13·0	420	450	280	550	300	620	180	420	250	640
1·94	13·5	530	430	500	530	450	600	190	400	300	610
2·26	10·5	—	—	700	800	390	900	160	600	220	920
2·58	13·5	590	580	730	710	520	800	90	530	300	810
2·58	13·5	390	580	600	710	390	800	190	530	390	810
2·58	12·5	450	620	450	770	390	860	180	570	180	880
2·58	13·0	360	600	450	740	330	830	180	550	250	840
2·58	14·0	730	560	790	690	560	770	100	510	300	790

sampling period. Each observed value is a mean figure for a period of five minutes. It will be noticed that in many cases the observed values fall short of the calculated figures. The latter concentrations are those to be expected when the plume impinges on the instrument for the full period. The observed figure over a five-minute period will fall short of this if the wind does not blow towards the point for the whole time or if the flow over the building causes the plume to reach the instrument only occasionally.

The finding that the observed concentrations seldom exceed the calculated values suggests that this simple method of calculation could be employed in many similar cases where pollution from a proposed chimney may cause some concern.

The response times of the instruments A and B on the roof were much quicker than the other three. It has been possible, therefore, to determine concentrations over much shorter periods at these points. It was found that, over a period of about half a minute the concentration could rise to 3 to 5 times the mean value for the five minute period. This roughly corresponds with the maximum value given by Halitsky, whereas the five minute average would correspond to the average concentration C.

Conclusions

The investigation is far from complete and it is, therefore not possible to reach any firm conclusions on the validity of wind tunnel tests.

The minor investigations described should provide information for the designer or town planner. The most important result obtained is to show how concentrations calculated from simple existing theories agree quite closely with measured figures.

Acknowledgment

The work described in this paper forms part of a research programme at Warren Spring Laboratory and is published by permission of the Director.

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DEVELOPMENTS IN THE COAL INDUSTRY RELATED TO CLEAN AIR

*by A. Alan Taylor, Ph.D., M.Sc., F.Inst.F.**

SUMMARY

A number of activities of the National Coal Board that are concerned with the promotion of a clean air policy are described. These include the development of open fire smokeless fuels (the first of which will be on the market this year), co-operation with other bodies on coke specifications and on the assessment of smoke emission, support of university research on fuels and combustion processes, the substitution of smokeless fuel for miners' concessionary coal, and collaboration with appliance manufacturers in the development of new and improved domestic and industrial applications of solid fuel.

THERE are a vast number of projects among the research and development being carried out by and for the National Coal Board that are furthering the efforts of this Society, either directly or indirectly.

In this paper I would like very briefly to dwell on some of our work that has a close bearing on the clean air objective. But besides research and development it should not be forgotten that in the last couple of years we have set up a country-wide organization of skilled fuel technologists whose services are available to industry and whose advice on the efficient use of solid fuel are bringing important benefits to users and the general public alike.

Smokeless fuels

The demand, in Smoke Control Areas, for solid fuel for domestic installations may not be limited only to smokeless fuel; later in this talk I will mention recent developments in domestic solid fuel appliances which are designed to burn bituminous coal smokelessly. Nevertheless, we have to bear in mind that for a long time to come the bulk of the demand for solid fuel will be for existing appliances, or for the smaller replacement or new appliances designed to burn smokeless fuel.

At the International Clean Air Conference in October 1959, Dr. Bronowksi reported on the progress which had been made by the Board in developing a premium smokeless fuel for the open fire. In this novel process the fuel produced had a high residual volatile matter content so that, although it was smokeless, it burned with long flames similar to ordinary coal. At that time the char which was produced by the fluidized process was briquetted on an extrusion press with and without a binder. For various technical reasons we have decided to discontinue work on briquettes made with a binder so that all briquettes made by the fluidized char process will be binderless.

The Board's declared aim is to make an outstanding fuel for the domestic open fire and work on the Birch Coppice pilot plant has progressed satisfactorily towards that goal. During 1962 briquettes of good quality were made on the extrusion press in a continuous run to obtain quantities for large-scale market trials and to obtain experience of production running. These briquettes had a hexagonal shape and altogether about 200 tons were produced for the first time on a semi-production basis. 28 lb. samples were sent out to members of the Distributive Coal Trade and to other organizations with an interest in this fuel, including this Society, the Domestic Coal Consumers Council, The Clean Air Council, etc. The replies from testers indicated an overwhelming approval for the briquettes. Almost everybody thought they were as good as existing premium smokeless fuels, and about half of them thought they were superior. This encouraging response convinced the Board that it would be worthwhile to adapt the Birch Coppice plant to a small-scale production unit. Plans have now been approved for the necessary modifications which will enable 1,000 tons per week of briquettes to be produced. It is expected that the fuel will be available for sale at the commencement of the heating season 1963/64, but because the tonnage available is fairly small, distribution will be made only to the North West, Midlands and London. Also, in an attempt to spread the tonnage available the briquettes will be packaged in 28 lb. bags.

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* Sales Promotion (Technical) Branch, N.C.B.

Plans for the full-scale commercial plant at Coventry are progressing satisfactorily; production is expected in 1965/66 and the capacity of the plant will be approximately 600,000 tons per annum. Mention has already been made of the fact that the briquettes which are, and will be, produced at Birch Coppice, have a hexagonal shape and are made on an extrusion press. However, we would like to be able to make briquettes from the char on a roll press since this is more attractive from several points of view, not least of which is greater throughput and lower cost. The difficulties are considerable in briquetting without a binder, but the problem has been solved on a small scale and at Birch Coppice work is proceeding to confirm this on a larger scale. The results of these investigations will be used in the design of the Coventry plant.

Although a full-scale production unit has not yet been built, the Board are completely confident in the process and have already tested a wide range of coals to confirm their suitability for the process. Sites are also being investigated and selected so that when a decision is taken to go ahead in other Divisions much of the preliminary and time consuming groundwork will have already been completed.

In his paper to this Society, Dr. Bronowski also advised that the Board were working on the production of a smokeless fuel by a mild heat treatment process. Work at the Graigola pilot plant was completed and the plant was therefore closed down in 1962. Plans for a commercial plant which will produce about 200,000 tons per annum are shortly to be considered by the Board and it is anticipated that this fuel will also be available to the public in 1965/66. The characteristics of this fuel are somewhat different to the fluidized char briquettes in that they give a very good closed appliance performance as well as being suitable for improved open fires.

Supporting research for the Birch Coppice development will be continued at the Board's Central Research Establishment at Stoke Orchard and will be concentrated mainly on outstanding briquetting problems. Studies will be made in the design problems involved in scaling up of fluid carbonization to commercial size and research will be directed towards the solution of the difficulties in extending the char briquetting process to coals of higher rank.

N.C.B. Research and liaison with outside bodies

It would be tedious if I attempted to do more than highlight some of the activities of the Board's Scientific Department that are related to Clean Air, and I propose to mention only a few examples and to show the links with outside organizations engaged on projects of a similar nature.

A considerable amount of work has been done in the past few years in co-operation with the British Coking Industry Association and the Gas Council in preparation of domestic coke specifications. In addition to investigations concerned with the carbonization plant process this has entailed the analysis and study of reports of numerous tests with typical appliances in which the fuel is burned. This work has been going on since about 1954 and in 1959 a specification for open fire coke was produced which required daily sampling at works. Coke before despatch is examined for moisture, undersize ignition and radiation characteristics. Since 1959 further work has been put in on this specification which is on the point of revision.

A specification for cokes for closed domestic appliances is well advanced. This specification is based primarily on testing of the smaller size coke as these are used in the smaller appliances where performance is most critical. The smallest size coke ("S") will be examined for moisture, undersize, oversize, shale, high output and banking characteristics in a boiler. The medium size coke ("M") will be tested for moisture, undersize, oversize and shale. The sampling pattern will conform to that for part one of the specification which deals with open fire coke.

Work on fuels which are purported to be smokeless is also being undertaken in co-operation with the B.C.U.R.A. with a view to preparing a British Standard for assessing smoke emission and a standard test has now been developed. Basically it requires different fuels to be burned under conditions of similar output in an improved open grate and when completed it will enable manufacturers and the Ministry to assess smoke emission on a common basis. During the course of these investigations it became necessary to evolve new techniques for determining the very small weights of deposits obtained from "near smokeless fuels" and a large amount of experimental work has been involved.

Support is given by the Board to research carried out at Universities in mining techniques, on fuels and combustion processes, and a good deal of this post-graduate research is concerned with smokeless combustion techniques. The Board also maintains close liaison with European and U.S. research and development organizations, and during the past few years the exchange of information and international co-operation has secured much of value.

Substitution of Miners' Concessionary Coal

The establishment of Smoke Control Areas in mining communities faced the Board with a difficult problem in having to make a break with a long-established custom. The miners' rights to concessionary coal have been jealously guarded and patient negotiations were required to effect means for substitution of smokeless fuel for concessionary coal.

Agreements between the Board and the Unions came into force on January 1, 1962, providing for the substitution of solid smokeless fuel or, in certain circumstances, cash in place of concessionary coal for mineworkers, cokeworkers and the relative supervisory and foreman classes living in smoke control areas. The Agreements made corresponding provision for retired workers, widows, etc., associated with these people. Since then substitution arrangements have been extended to the rest of the Board's industrial staff. In the case of the Board's non-industrial staff substitution arrangements have already been introduced for a number of classes and are under consideration for the rest.

The Agreements made in the case of the mineworkers, cokeworkers and associated classes provide that the smokeless solid fuel supplied will normally be coke made by the Board (*i.e.* "Sunbrite") but that where it is more convenient for the Board to supply an alternative smokeless solid fuel, or the concessionaires' appliances cannot burn such coke, the Board will consult with the local Union representatives before deciding whether:

(*a*) to supply some other solid smokeless fuel produced by the Board which is suitable to the man's domestic appliances, or

(*b*) to buy solid smokeless fuel from another supplier who will arrange for its delivery to the mineworkers, or

(*c*) to make a cash payment in lieu of the solid smokeless fuel.

The entitlement under these Agreements are agreed at national level between the Board and the Unions and are expressed as a monetary figure. Thus those who are entitled to an allowance of solid smokeless fuel may receive within a calendar year that amount which can be purchased at current local retail prices for the figure appropriate to his category (*i.e.* according to whether he is a serving worker or retired person, etc., a householder, sub-tenant, etc.).

In certain circumstances the Board will make a cash payment in lieu of a supply of solid smokeless fuel to persons whose heating appliances will not burn it. They will not, however, make a cash payment to anyone who is unable to burn solid smokeless fuel in his home by reason of his having, after the effective date of the appropriate agreement or the date when he first joined the Board's service, whichever is the later, made conversions to his home so as to preclude the use of solid smokeless fuel when he could by his own choice have moved to other suitable accommodation which was so equipped.

The Agreements define the solid smokeless fuels which may be supplied as:

"Any of the following fuels, being authorized fuels for the purpose of the Act, namely:

(*a*) anthracite;

(*b*) any briquetted fuel carbonized in process of manufacture;

(*c*) coke;

(*d*) any low-temperature carbonized fuel;

(*e*) any low-volatile steam coals;

(*f*) any other solid fuel which may at any time be authorized for the purposes of the Clean Air Act, 1956."

With effect from August 1, 1962, the Board agreed to provide similar substitution arrangements for concessionaires living *outside* smoke control areas who, because of their domestic heating arrangements, can burn little or no concessionary coal. This arrangement will provide for the case, for example, of a man living outside a smoke control area, otherwise entitled to concessionary coal, who decides to install solid fuel central heating in place of open fires.

Development of Improved Combustion Appliances and Equipment

The development of improved solid fuel appliances, both for domestic use and for industry, is my own particular responsibility within the Board, but it is not for this reason alone that I shall deal with it rather more fully. It is because I firmly believe that through better combustion applications we shall not only be able to satisfy consumers on efficiency, ease of operation and convenience, but will be able to make a real contribution to cleanliness in the house, the factory and outside.

Industrially, of course, the work is geared almost entirely into improved use of bituminous coal, but in the domestic market it has to take account not only of the existing natural and prepared smokeless fuels, but also of the new fuels which have already been referred to, and the smokeless burning of bituminous coal. The Board's programme for the intensive development of combustion appliances is comparatively recent. The primary purpose of this work is, quite naturally, directly related to the promotion of the Board's products. Nevertheless, we have taken a very broad view of our responsibilities and accept that the only way to real success lies not only in getting better appliances but also high efficiencies and smokelessness via research in the performance of fuels and in combustion techniques.

To begin with we had to identify the particular fields in which our efforts should be concentrated to achieve positive and early results. Broadly speaking we are concerned with two main classes of appliances and equipment; one may be classified as "domestic" and includes the space and hot water heating equipment used in dwellings and small central heating installations; the other covers the small industrial type of equipment and this may be taken to include combustion appliances and ancillary equipment for commercial buildings, schools, hospitals and so on, and also small and medium size boiler plant for industry generally.

The operating costs of domestic heating and hot water supply are undoubtedly lowest with a solid fuel installation, but the criticisms most frequently levelled at such appliances are that labour and convenience factors compare unfavourably with other fuels. Also, in addition, many appliances were not well adapted to getting the best performance with the cheaper smokeless fuels.

The primary objectives in these new developments were, therefore, to reduce refuelling and de-ashing to a minimum and to secure efficient performance with a wide range of smokeless fuels. The help of the appliance makers was enlisted and their vigorous response and active co-operation is highlighted by the fact that new appliances are now coming forward in increasing numbers which embody many of the requirements put forward by the Board.

So far as domestic boilers are concerned these may be summarized as possessing the following features:

(*a*) ability to burn a wide range of smokeless fuels—particularly hard coke—efficiently and satisfactorily;

(*b*) ability to burn for long periods without refuelling or de-ashing, *i.e.* up to 10 hours or more at full load and 24 hours at normal, average, load;

(*c*) easy and clean de-ashing and ash removal equipment;

(*d*) simple and clean design with easy access to all operating components.

The next stage of development is already in hand and here the object is to provide boilers with more automatic features and with luxury extras for automatic ignition and automatic de-ashing.

The design and development of openable stoves and improved open fires has not been neglected, and the growing popularity of the former, by virtue of new and improved styling, and particularly by securing the advantage of "the open fire behind glass" whilst obtaining high efficiency with smokeless fuel, is evidenced by the greatly increased sales of this type of room heater.

We are also giving a good deal of attention to research and development aimed at the production of warm air and central heating appliances capable of burning bituminous coal smokelessly and already one type of appliance has reached the market; this incorporates a miniature underfeed stoker and is available as a bunker flow model with the amenity to run automatically for long periods without attention.

In the sphere of industrial boiler plant our aims are principally high efficiency, smokeless operation, automatic operation, convenience and competitive capital costs.

With these objectives in mind the Board, in the closest liaison with the manufacturers, have initiated a programme of development of boilers and mechanical firing, and of fuel and ash handling equipment. A great deal of thought is being given to means of eliminating labour and improving convenience of operation while, at the same time, securing a high sustained operating efficiency and freedom from breakdown.

It is often difficult to justify the installation of fairly elaborate coal and ash handling equipment in the smaller boiler house and a high priority is being given to the development of cheap handling equipment. It is possible, for instance, to reduce manual ash handling to a minimum, certainly to remove the more onerous part of this labour, by the installation of a mechanical ash extractor which discharges the ash into a wheeled container at the front of the boiler, or at a convenient point beneath the boiler shell. The ash can then be removed manually or discharged into a large capacity bin by means of a screw elevator.

Development projects on new and unconventional systems of firing are proceeding and in addition a comprehensive study is being made of pulverized fuel firing systems for medium size boilers.

All our efforts in these fields are, of course, aimed principally at maintaining the competitive position of the Boards products in Britain's fuel market. With coal as the only important indigenous raw material of the country it is important that this should be so. There is no doubt that coal can be used more cleanly than it is, and by efforts on our part and on the part of users can make a real contribution to clean air. We are confident that substantial improvements have already been made, and that the further work now reported will add its contribution.

THE GAS COUNCIL'S SEARCH FOR NATURAL GAS AND UNDERGROUND GAS STORAGE

by

Charles Johnson, A.M.I.C.E., M.I.Mech.E, M.I.Gas E.[*]

SUMMARY

The value of natural gas to the gas industry, and of the underground storage of gas, especially for meeting the winter peak demands, are discussed. The search for natural gas in this country, and for suitable geological formations for its storage are described. Six gas reservoirs on the lines envisaged would be equivalent to 10,000 large gasholders. Legislation will be required before gas can be stored underground, and the practical aspects of storage are considered. The surface works required with underground storage would be unobtrusive and create little problem on account of landscaping and amenity.

The Need for Geological Search

When the gas industry was nationalized in 1949 early consideration was given by the Gas Council to long-term plans for the most economical methods of gas production in a steadily expanding market. An appreciable quantity of gas was already being purchased from the coking industry and a little later on rich gas became available as a result of the expansion of the oil refining industry in this country. Significantly large quantities of natural gas were being discovered in many parts of the world, sufficient to change materially the economic situation of some of the countries concerned. These discoveries were being made closer and closer to Britain and it became apparent that it would be unrealistic to plan the future programme of gas production without making some attempt to assess the prospects of discovering indigenous sources of natural gas in commercial quantities. Another, and very important, economic consideration of gas supply was the growing disparity between the summer and winter demands for gas, mainly by reason of the increasing popularity of gas for space heating generally and domestic heating particularly. About fifty per cent. more gas is now being used in the winter than the summer and on this 2:3 ratio one-third of the gas production plant is idle in the summer months. Obviously in that time advantage is taken of the opportunity to carry out maintenance and renewals: even so, the period of enforced idle time far exceeds repair requirements.

Until recently it has been a matter of compromise to maintain relatively expensive coal carbonizing plants at the appropriate level of operations, to dispose of the resulting coke either by sale or by use for the manufacture of water gas in the winter and to have in reserve sufficient peak-load plant to meet the balance of winter demands at not too high cost, having regard to the comparatively low load factor inevit-

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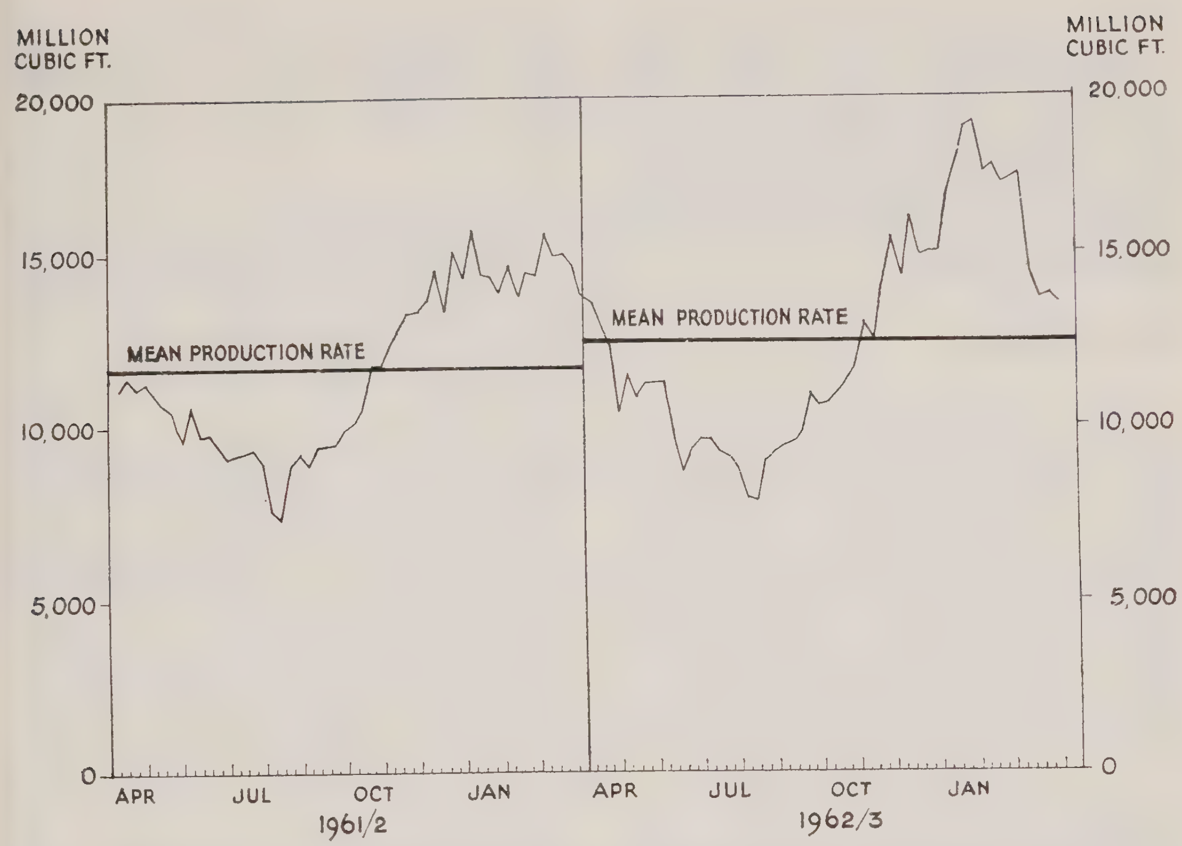
[*] Coal Officer. The Gas Council.



WEEKLY TOTALS OF GAS SENT OUT APRIL 1961 TO MARCH 1963

Figure 1

ably associated with peak-load plant. If the winter consumption of gas continued to increase disproportionately to the summer consumption it would be beneficial to have some reserve of natural gas on tap, or to store surplus gas underground in the summer and recover it in the winter during times of high demand. As earlier indicated, the yearly output of gas is supplied as to 40 per cent. in the summer and 60 per cent. in the winter. If 50 per cent. of the total requirement of gas could be made in the summer and the excess 10 per cent. put to store for recovery in the winter the production plant would be able to operate at a uniform rate throughout the year, other than for short periods of shut-down for maintenance. These broad characteristics of gas supply provide the attraction of seeking indigenous natural gas to help meet the winter demand. If adequate sources of natural gas can be found and used, the depleted reservoir structures could subsequently be refilled with gas surplus to summer requirements, so providing an economical strategic reserve.

Storage

A variation on the attractive theme of using indigenous natural gas and subsequently using the gas reservoir for the underground storage of other gas is the possibility during the search for natural gas of finding geological structures of appropriate shape which contain water. The water could be forced out by the injection of surplus gas, thereby creating an artificial gas reservoir or underground storage. The optimum storage of this kind under current conditions would not need to exceed the 10 per cent of total gas supply previously mentioned, say 60,000 million cubic feet out of a total annual disposal of approximately 600,000 million cubic feet. The conventional gasholder rarely exceeds a capacity of six million cubic feet, so on these figures the desired scale of operations can be readily visualized as the equivalent of 10,000 large gasholders. Ideally, no more than about six storages would be needed, and if spread about the country, each ought to have an operational capacity ranging between 5,000 and 15,000 million cubic feet.

Cavity Storage

It has frequently been asked whether natural cavities in the ground, or caves, could be used for the storage of liquids, liquefied petroleum gases or other kinds of gases. Naturally occurring cavities are not secure or gas-tight by the very nature of their origin and formation, although in some instances it would be possible to render them tight enough for storage. Artificial cavities made by the controlled extraction of minerals can be safe if suitable design and construction are followed in the course of their creation. In the case of coal mines there is the inevitable difficulty due to settlement of the over-burden, but this particular happening is usually capable of reasonable control. Cavity storage of liquids and liquefied gases is being developed in some countries abroad and probably will be developed here mainly for the storage of liquefied petroleum gases. These are gases that are liquefiable by an increase in pressure or a reduction in temperature. There is one instance in this country where a cavity of controlled shape was constructed for the storage of a modest amount of town gas by leaching out the salt from a deep bed.

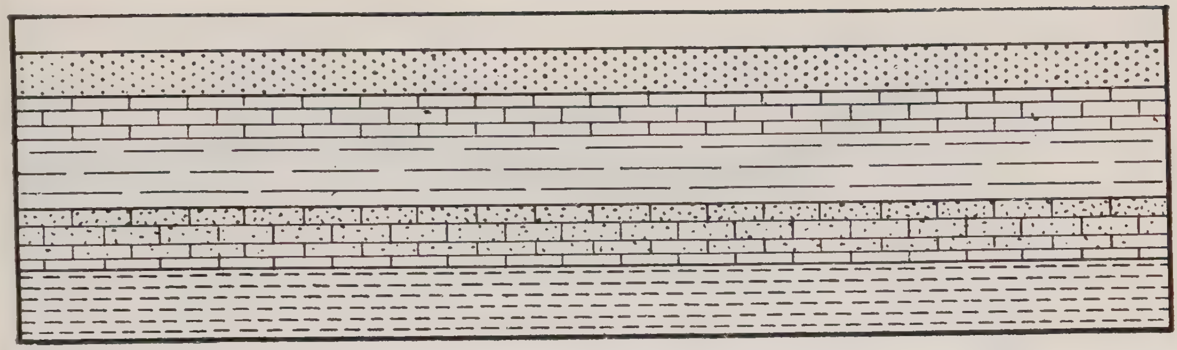
Underground Storage

The term underground storage is generally meant to relate to storage of the very large volume of gas sufficient to absorb a substantial part of the seasonal difference between summer and winter demands. Such storages are not cavities: they are fundamentally different from cavities in that storage is in porous rock and not in free space. The remainder of this account is concerned only with underground storage in porous rocks and not in empty cavities, chambers or mine galleries, however they may occur.

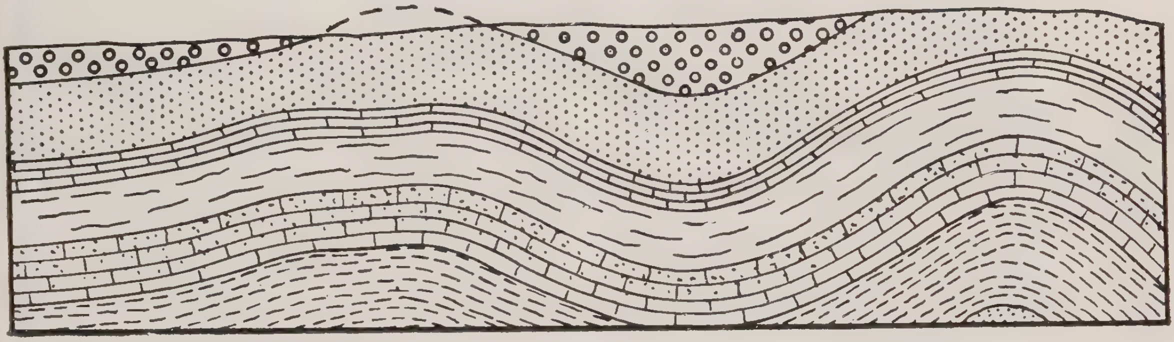
Geology of Structures

The surface of the earth down to a very substantial depth can conveniently be considered to consist of a series of superimposed layers of sedimentary rocks laid down in successive eras of geological time. The gradual cooling and shrinkage of the earth's crust has resulted in a considerable degree of folding, upthrusting and faulting. In those successive eras a variety of deposits has been laid down, mainly as decayed vegetation over the land surface and as sedimentary deposits when the land surface was submerged below the sea. It can be appreciated, therefore, that buried organic matter has been the source of hydrocarbon minerals as coal, oil and natural gas, and that other forms of deposition have resulted in the laying down of a variety of rock forms ranging from completely impervious solids to porous limestones and sandstones and sand beds. Water-soluble minerals, under the influence of heat and pressure, have crystallized and also occur as impervious layers.

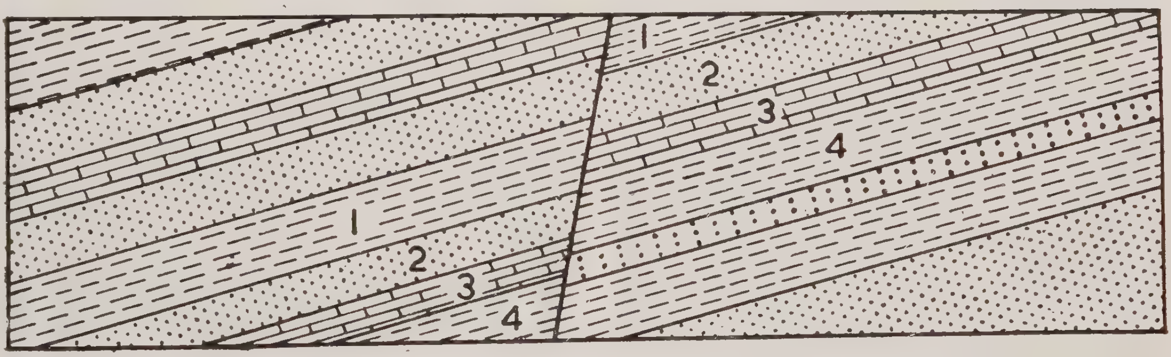
Prolonged geological investigations and explorations permit of a reasonably predictable picture of how the various types of rock occur, and the extent to which they have been folded to produce a highly variable series of ridges and valleys. During the course of upthrusting and folding some of the deeper series of rocks have come to the surface, and in the case of porous rocks this has permitted the escape of any gas that might have been present and has left indications of oil or coal where these earlier occurred. The exposures of porous rocks allow water to flow inwards or outwards at the land surface according to relative surface levels, and this is the origin of the system of underground water movement. Because surface water can flow into a stratum of porous rock at one level and flow out again at a



(*a*) *Section of strata before folding begins*



(*b*) *Early stages in folding*



(*c*) *Fault trap*

Figure 2. Stages of strata folding

lower level, also because there is resistance to flow according to the permeability of the rock, so there is water pressure or hydrostatic head within the system. Nominally 100 feet head of water is equal to a pressure of 43 pounds per square inch, and this is an important factor influencing the pressure at which gas and oil occur naturally and the pressure at which gas can be stored. If a stratum of porous rock is suitably undulated, traps will be formed which in appropriate circumstances will contain gas, or oil, and water or, most often, only water. In the last mentioned instance the trap or structure is described as an aquifer. Such a geological structure can only serve as a reservoir to retain gas or oil if it is completely sealed in all directions. It must therefore be overlaid by an adequate cover of impermeable cap rock, sufficient to overcome the hydrostatic pressure in the reservoir structure. The underlying water residing in, or flowing through, the porous rock will then seal the perimeter of the reservoir, just as an inverted cup resting in a saucer of liquid is sealed and can retain its contents. Anticlinal structures of such a kind in this country rarely exceed

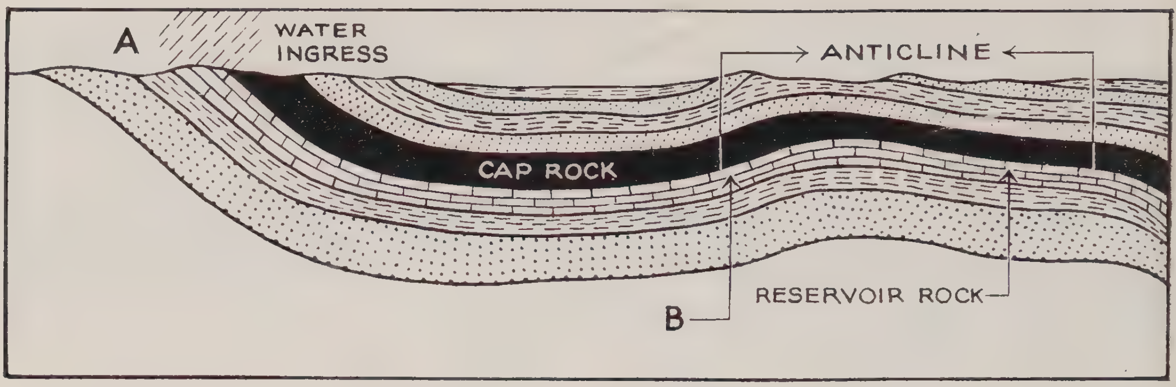


Figure 3. Anticlinal structure

five miles in length: the porous rock strata within them are frequently of substantial thickness and adequate to serve as a gas storage. It can be appreciated from the foregoing that if a well were sunk from the surface of the earth, down through the cap rock of a structure into the porous rock below, the hydrostatic head there would force the contents up the well. Any gas or oil residing in the reservoir would be recoverable from the well by displacement as the subterranean water encroached according to its pressure or hydrostatic head. Conversely, if gas were to be pumped down the well under superior pressure the resident water in the reservoir would be driven out of the porous rock and an artificial gas storage would then have been created.

For reasonable economy of size it is desirable to store gas at a pressure of a few hundreds of pounds per square inch and this entails a depth below surface of about 1,000 feet, more or less. The lateral shape of the structure is not particularly important, except that a circular formation represents the ideal, and a superficial area of at least five square miles is desirable. Porous rock strata vary greatly in thickness and are frequently up to 100 feet or more; an average effective thickness of about 50 feet would be mainly preferred. The amount of gas, oil or water that can be held in unit volume of porous rock depends upon the size and distribution of the grains or particles making up its matrix. There are various physical complications associated with water displacement by gas but it can be reckoned that when serving as a gas reservoir 12 to 20 per cent of the rock volume will be occupied by the gas and a similar amount by the water. For a formation at a depth of approximately 1,000 ft. the nominal reservoir pressure would be of the order of 430 lbs. per square inch, and according to Boyle's Law unit volume of pore space in the reservoir rock would store approximately thirty volumes of gas. On such dimensions as these a reservoir structure would have an operational capacity of about 10,000 million cubic feet of gas. The actual capacity would be about twice this figure but not all of the stored gas would be recovered operationally over each period of seasonal withdrawal.

Method of Search

At this point of description of the nature of the occurrence of rock formations below ground it needs to be remembered that the several layers, even if they lie in reasonable conformity, consist of widely different materials. These range from the completely impervious cap rocks such as clay, marl or crystalline rock to the various porous rocks as limestone, sandstone or sand, and their order of occurrence must be right.

The problem is how to find structures at depth that have all the necessary physical characteristics and properties. Fortunately, geological information derived from boring operations is

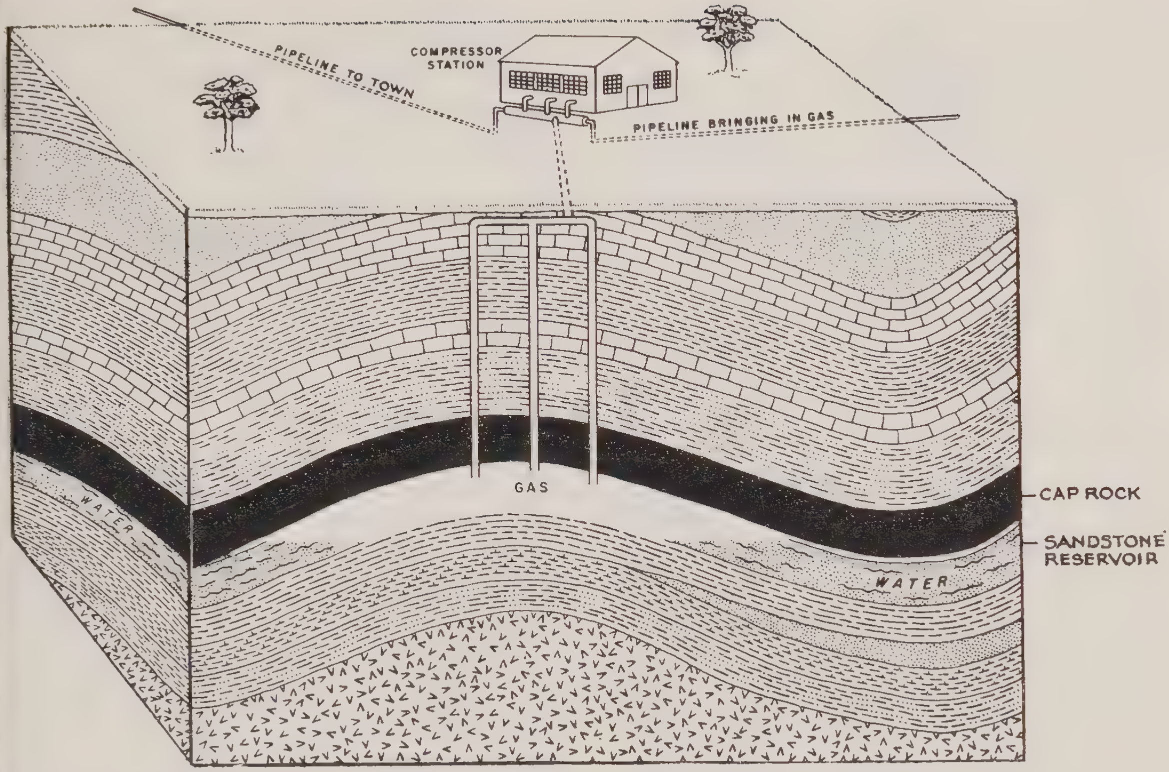


Figure 4. Storage structure

correlated by the Geological Survey and is sufficient to allow fair prediction of the whereabouts of the impervious cap rocks and the porous reservoir rocks, as well as of the nature of the flow patterns of subterranean water. The geological history of the British Isles is of a series of fairly vigorous disruptions which have resulted in faulted structures and formations, and on this account many potential areas have been rendered useless. However, some semblance of systematic search can be founded on the knowledge that the Wealden and Lower Greensand of the South of England, generally in an area stretching from the Hampshire Basin to Kent, have good geological characteristics and are under a substantial cap rock of Gault Clay. More generally in the Midlands and up both sides of the country to the North of England is the Triassic system in which lie porous rock formations, again well covered by substantial cap rock. Several Midlands areas have shown some promise, particularly as much of the formation water is frequently found to be brackish and therefore of no value for public supplies. Underlying the Triassic system north and south of the Humber is the Permian formation which also has encouraging characteristics, and in Yorkshire is yielding natural gas in commercial quantities. The coal mining areas of the Midlands and Scotland are into the Carboniferous system and this is known to contain reservoir structures, because natural gas and oil have been discovered there. The Carboniferous mainly appears to have suffered the effects of severe geological upheavals: it is consequently unconformable and faulted and this makes exploration somewhat speculative.

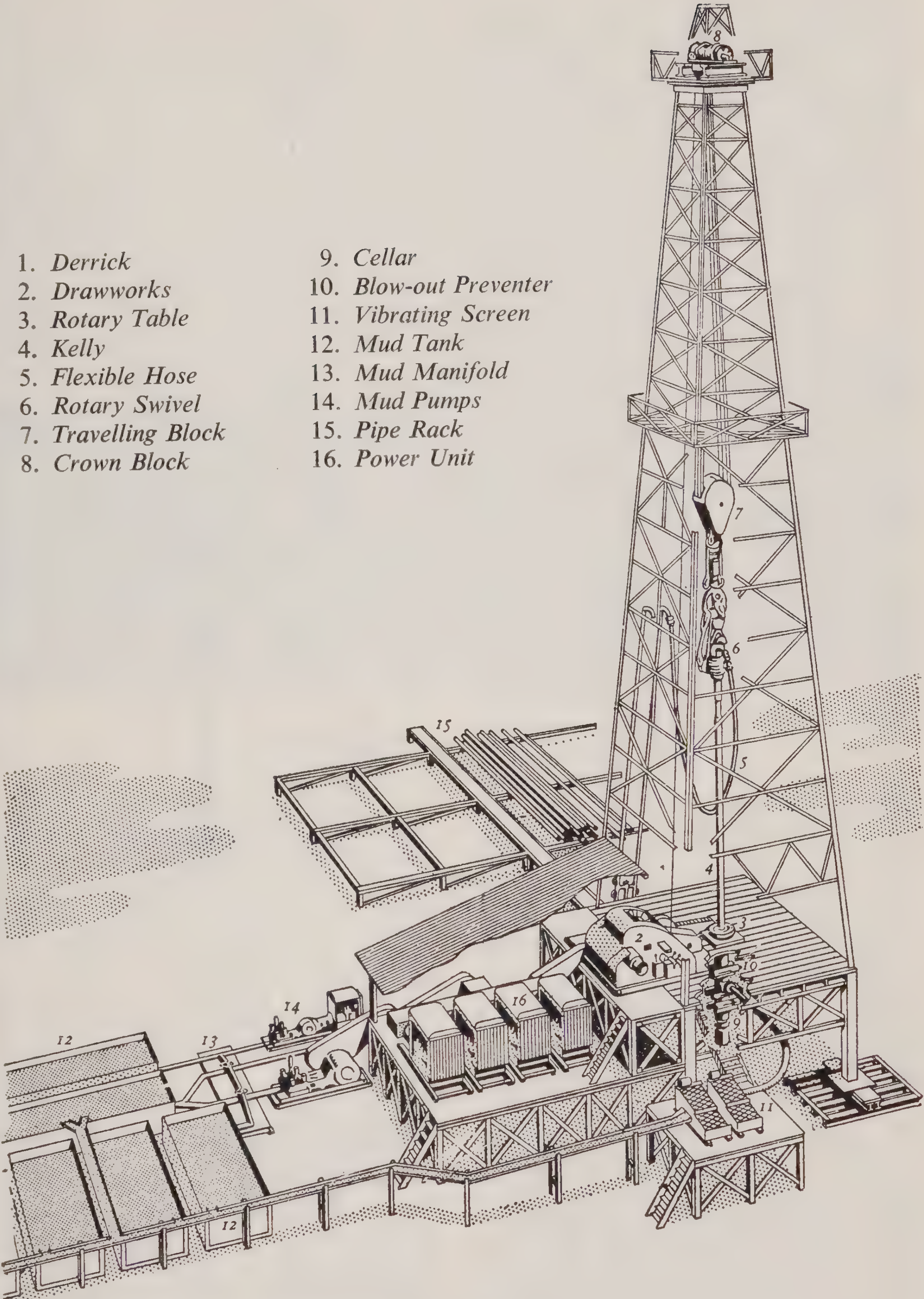
The Gas Council's explorations, extending over the past ten years, started with seismic surveys in the North Midlands and in the South as an economical method of locating potential geological formations before incurring the expense of drilling. Changes in depth of underlying rocks can be traced approximately by measuring small changes in the earth's gravity and magnetism. Information about different rock interfaces and junctions at depth can be obtained by the detonation of small dynamite charges in shallow shot-holes and measuring the sound waves as reflected and refracted from the rocks. These tracer techniques provide information which permits of some prediction of the succession and shape of the deep strata. In some phases of the Council's search in the South of England preliminary exploration has been by boring shallow holes to varying depths in the range 300 ft./700 ft. to trace the structural shape of the shallower formations. This information can be used to forecast the likely shape of the object rocks at greater depth. The hydrocarbon reservoirs in Britain appear unlikely to be of the enormous size found in some other countries and so the capital expenditure at risk needs to be on a cautious scale. It is for this reason that modest surveys methods have been favoured and it is questionable whether any material loss of time has resulted therefrom.

Progress of Search

To date the total depth of deep and shallow boring on the Gas Council's account amounts to about 200,000 linear feet. About one-third of this has been for wells ranging in depth from 800 ft. to over 7,000 ft. and the remainder for the shallower holes drilled for preliminary appraisals. In Scotland the Midland Valley was believed to be a promising Carboniferous prospect, as indicated by three discoveries of gas in the course of earlier oil explorations. One gas reservoir near Edinburgh is in a modest way of commercial production and there is the possibility of its eventual use as a gas storage. Two deep wells have been drilled in North-East England without success, but at Eskdale, nearby, natural gas is being produced in commercial quantities for the North Eastern Gas Board's supply to the Whitby area. In the South Yorkshire coalfield a small gas reservoir has been discovered and further south in Derbyshire two more gas reservoirs have been located. The known small occurrences of natural gas in the South of England have been investigated by the drilling of new wells in selected locations in Sussex but the results have shown little promise. More drilling is programmed and it is possible that further gas indications will be forthcoming as a result of drilling into anticlinal structures to identify suitable formations for storage. Apart from potential storage in some of the known natural gas reservoirs after the gas has been withdrawn, it is evident that the Chilcomb structure near Winchester is a possibility. Adjacent to Portsmouth there is a much bigger structure but this is an unfavourable geographical location as well as being very close to a heavily populated area. At the present time the search programme is mainly concentrated on an extensive area eastwards from the Cotswolds to the Norfolk coast: two potential storage structures have been identified and the search is being continued in the hope of finding others. The Government have promised to introduce public legislation for the development of underground storage and by the time this comes about the Gas Council should be in a position to go ahead with its construction plans.

Development of a Storage

It is important that a gas storage well should be completely leakproof and so the steps taken to ensure this may be worthy of description. In a typical instance the initial boring may start at approximately 15 in. diameter and go down several hundred feet, preferably into an impervious layer. A steel casing tube of 12 in. diameter is fitted into the borehole in 30 ft. lengths, screw-coupled and centralized by spring-wire locators. The casing is grouted to the wall of the borehole throughout its length by forcing liquid cement down the tube under extreme pressure until it rises to the surface in the annulus between the outside of the tube and the wall of the borehole. The amount of cement required for this operation is exactly



1. *Derrick*
2. *Drawworks*
3. *Rotary Table*
4. *Kelly*
5. *Flexible Hose*
6. *Rotary Swivel*
7. *Travelling Block*
8. *Crown Block*
9. *Cellar*
10. *Blow-out Preventer*
11. *Vibrating Screen*
12. *Mud Tank*
13. *Mud Manifold*
14. *Mud Pumps*
15. *Pipe Rack*
16. *Power Unit*

Figure 5. Rotary drilling rig equipment

batched and, after placing, is followed by pumping down sufficient mud to fill the inside of the tube. This serves the purpose of retaining the cement in position under pressure during the setting time and of keeping the tube bore free of cement. Boring is then resumed at 12 in. diameter down to a further convenient depth when a second steel casing tube of 9 in. diameter is fitted into the well from top to bottom and the annulus is pressure grouted as before; in the upper section this annulus is between steel and steel, and in the lower section between steel and borehole. Boring is again resumed to finished depth and a 6 in. diameter steel casing is fitted the entire depth of the well and pressure grouted as for the others. This method of construction is believed to ensure absolutely gas-tight conditions between the porous formations and the well and to preclude any leakage up the outside of the well into other formations above.

In the course of the drilling, the tool cuttings are flushed to the surface by the cutting fluid and can be tested for identity of the rocks. Special cutting tools are used at prescribed depths to cut and recover core samples for more accurate analyses to be made, and from this information is decided the exact depth at which the well casing will be perforated to communicate with the porous rock. Perforation is effected by lowering a cartridge of heavy shot to the agreed depth and detonating a charge which fires a pattern of bullets through the casing and through the surrounding cement grout into the formation.

Comparisons of British reservoir rocks with those operational in other countries indicate that a single production well would be capable of delivering up to five million cubic feet, possibly more, of gas a day, so that a group of ten wells, or perhaps up to twenty wells on a big storage field would produce the equivalent of a large gasworks. Although the reservoir structure at depth would extend over several square miles, the operational wells would be grouped within a comparatively small crestal area of the structure. There would however need to be several monitor wells spaced strategically around the perimeter of the storage to indicate the extent of gas and water movements at selected locations. All the operational wells would be connected together by a pipe network laid below ground and this would connect through meters,

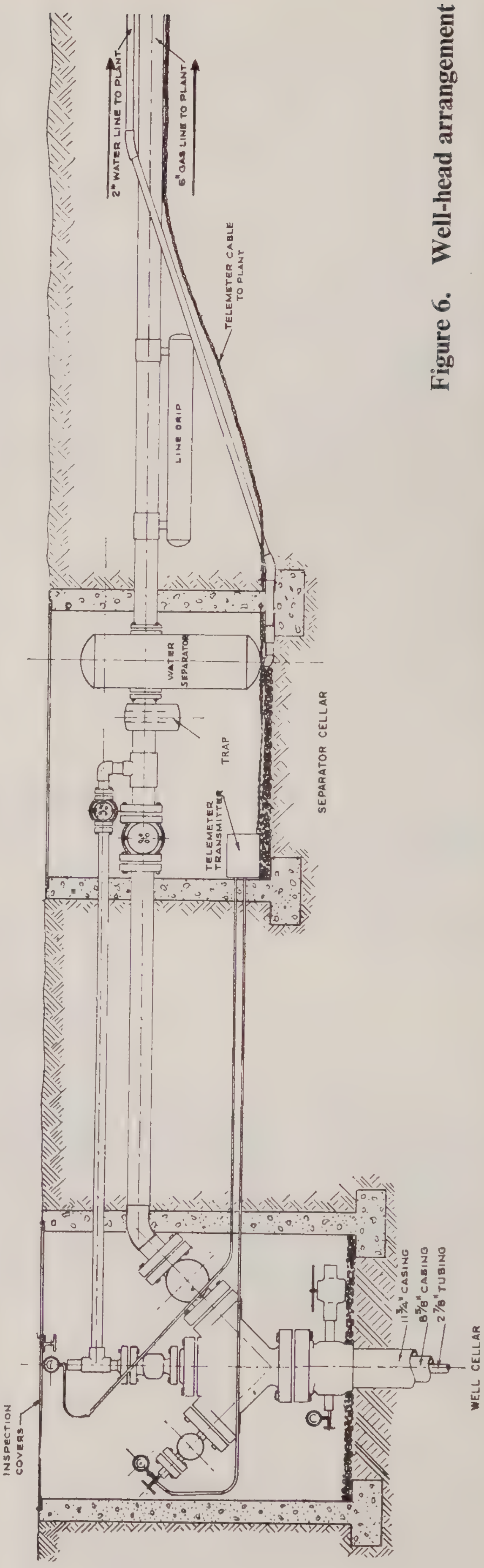


Figure 6. Well-head arrangement

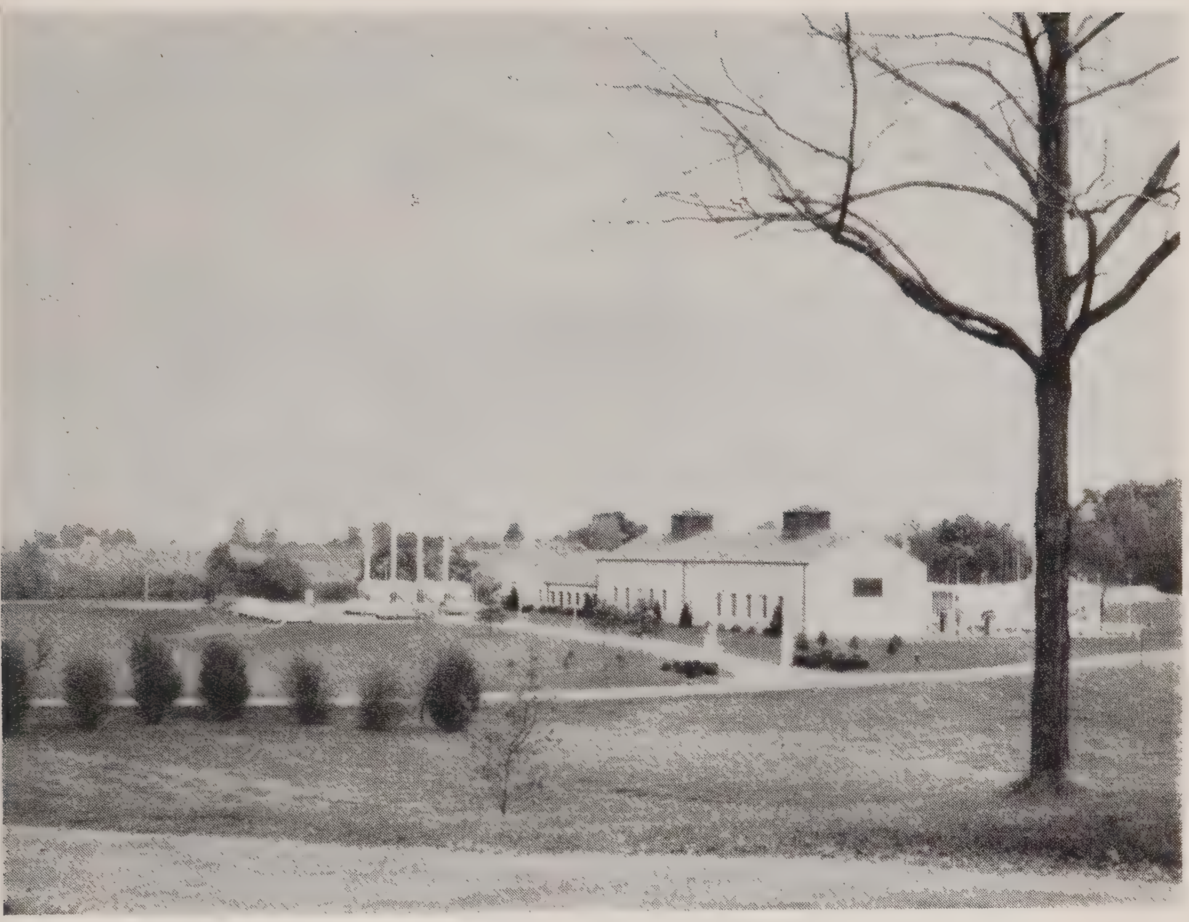


Figure 7. Picture of gas storage field

pressure controllers and any gas treatment plant that might be necessary to the main supply line. The well-head control equipment such as valves, flow meters and sand and water filters could all be housed in cellars below ground level, so that the only evidence on the surface would be a central meter and control house and possibly a gas compressor.

Very little landscaping is required to absorb a storage field into its environment as there is no more silhouette than with agricultural buildings. It is the fact that one German storage is immediately alongside an airfield, yet is not regarded as an undesirable feature. In this country the development of storages would enable the industry to meet the winter demand with less production plants and fewer gasworks. It is recognized that when the substantial imported methane scheme comes into operation next year even limited underground storage would be beneficial in addition to the above-ground tank storage at the ocean terminal. Incidentally, the storage of methane compared with town gas has two significant advantages. First, the calorific value of methane is twice as much as the calorific value of town gas, therefore twice as much energy can be stored for the same effort at the same cost. Secondly, the storage of methane overcomes any fears, unfounded as they may be, of possible tainting of water supplies. It is true that the latest systems of gasification using petroleum refinery products are cheaper and more versatile than any other large scale plant previously available. These new plants are therefore destined to have a favourable impact on the economic aspect of meeting the winter gas demand but they do not necessarily solve completely and economically the main physical problem of sheer availability. Even so, winters as severe as the last one have very few terrors for the gas industry and would have none if underground storage systems were in general use. The industry is anxious to progress along such lines as these and it confidently looks forward to abundant supplies of gas under all circumstances, possibly at an even more competitive price as the old order changes.

POWER STATIONS AND CLEAN AIR

*by G. N. Stone, B.Sc.(Eng.) and A. J. Clarke**

SUMMARY

This paper discusses the chimney emission problems presented by power stations and the techniques developed for dealing with them. A substantial programme of major improvements has been put in hand at small, older power stations where closure has not been possible. At medium sized power stations, there has been a continual search for better operating and maintenance procedures. Large modern power stations with coal consumption of up to 20,000 tons a day are planned with a confidence which derives from (*a*) accumulated experience of operating the largest integrated electricity supply system in the world, (*b*) the results of considerable research and experimentation in the field of chimney emissions, and (*c*) the use of internationally recognized methods of theoretical calculations. The objectives of current design are to achieve complete and smokeless combustion of fuel, to clean the gases as far as is practicable of solid particles and to discharge the remaining products of combustion at high velocity and temperature through a minimum number of very tall chimneys.

Dust deposit gauges and lead dioxide candles are maintained by C.E.G.B. around large numbers of power station sites. An analysis of 16 "before and after" surveys of dust and SO_2 is discussed. These measurements confirm that power stations as a rule do not materially increase the pollution level in their neighbourhood.

Research has included a study of chimney plume behaviour including the rise of a plume due to its velocity of emission and thermal buoyancy and subsequent diffusion. Instruments developed to assist in research have included continuous SO_2 meters, directional deposit gauges, flue dust monitors, balloon tracking techniques, photo-microscopic techniques for identifying dust and new methods of size grading of dust. Reference is made to research into dry sorption processes for removing SO_2 from flue gases. Currently, one of the most important tasks for research is determining the largest size of plant, that can rely upon tall stacks and thermal buoyancy for adequate dispersal.

Introduction

LITTLE need be said about the obvious benefits of electricity as a clean fuel at the point of use. The dramatic upsurge of domestic electricity demand in the last few years, much of it for space-heating, is itself evidence that people are willing to pay the necessarily higher price for a fully "processed" fuel in exchange for convenience, consistency and cleanliness. In industry, too, conversion to electric power has meant the disappearance of many small boiler plants, often situated in or near residential areas, which have sometimes been the source of troublesome emissions. The increased use of electricity and the concurrent elimination of small individual sources of emission must, however, be matched by vigilance of emissions at the point of electricity production if the maximum benefit to clean air is to be realized, and that is the subject of this paper.

The Electricity Generating Industry

At April 1st, 1963 the Central Electricity Generating Board owned and operated in England and Wales 236 power stations with a total installed capacity of 34,211 MW. Of these, 201 stations totalling 32,978 MW capacity were conventional steam stations burning coal or fuel oil. (The remainder consist of nuclear, hydro and diesel stations; none of which are considered further in the present paper).

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* Central Electricity Generating Board.

The fuel consumed by power stations in 1962/3 amounted to some 58½ million tons of coal and 5½ million tons of fuel oil. This is, of course, a large consumption; in fact, so large a consumption for a single purpose that it is particularly important to keep it in perspective. If the fuel used for electricity generation is deducted from the nation's total consumption, there still remains some two-thirds of all the coal and seven-eighths of all the oil-derived fuels as the proportions at present used for other purposes. Much of the latter will, in addition, be burnt in very small individual installations where the control of combustion and the manner of discharging the waste gases into the atmosphere are markedly inferior to those of even the older power stations. The relative importance of these and other factors have been discussed elsewhere (Ref. 1), and it is not the present intention to elaborate on them. It can reasonably be asserted, however, that on the national scale the direct contribution to cleaner air to be expected from the process of electricity generation is important, but not decisive, and material improvement in the air we breathe will be derived from progress in other quarters.

The essential problem of power station chimney emissions is, therefore, the local one of ensuring that the air in the vicinity of a station is not rendered objectionable by the station's operation. In achieving this, the Generating Board can justly claim to have played a considerable part in pioneering the general principles now increasingly being adopted by other industries and other nations; principles which can be summarized as:

(*a*) To achieve complete and hence smokeless combustion of fuel.
(*b*) To clean the gases as far as is practicable of the solid particles.
(*c*) To discharge the remaining products of combustion at high velocity and at an elevated temperature through the minimum number of very tall chimneys.

Taken together, these measures ensure the lowest possible concentration of pollutants at ground level in the neighbourhood of a power station.

A Current Review

In a paper of limited length it is impracticable to range over the whole of the Board's activities in the clean air field, and the aim of this paper is therefore to briefly review the current scene and to highlight some of the major problems and achievements of recent years. For this purpose it is convenient to divide the Generating Board's power stations somewhat arbitrarily into three categories which serve to typify the different sorts of emission problems that have to be resolved. In the first place, there are the very small stations dating from well before World War II which are nearing the end of their useful life; secondly, there are the medium sized stations of the immediate pre-war and post-war periods; and, thirdly, there are the very large stations recently commissioned, or still under construction. As implied above, the Board's power stations do not in practice fall quite so neatly into these three categories but in Table 1 the 201 stations, which are the subject of this paper, are divided into three age groups which correspond fairly closely with the above definitions (but excluding stations still under construction). The total capacity and the fuel consumed in 1962/3 by each group are given in the Table.

The Small Power Stations

The universal problem here is that of age and obsolescence. Most of these stations were built by local authorities or private power companies in an era when public tolerance of emission was greater, when knowledge was more limited and hence the standard of design was lower than is considered acceptable today. In addition, the wear

TABLE 1

Mean Age of Station at 1.4.63	*Number of Stations*	*Installed Capacity MW*	*Fuel consumption*—1962/3	
			Coal & Coke million tons	*Oil million tons*
30 years or more . .	56	2,477	1·7	—
6–30 years	115	19,575	35·2	2·7
6 years or less . .	30	10,926	21·7	3·0
Total	201	32,978	58·6	5·7

and tear of a lifetime of useful service has in some cases rendered even the primitive methods that were provided for the control of chimney emissions less than fully effective. These stations represent only a very small part of the Board's total output capacity and their use is restricted to a few hundred hours a year. From the point of view of both the public and the Generating Board, the most satisfactory solution to the problem of emission from these small stations is to shut them down as soon as possible.

Unfortunately, one of the consequences of the recent extremely rapid growth of electricity demand has been to defer for a few years the planned closure of many old stations. In the circumstances, the previous reluctance to incur heavy capital expenditure on modernizing and re-equipping old stations with only a very limited remaining life has been superseded by a major programme of improvements aimed at raising the standards of emission to something more in line with modern practice.

In formulating this programme an impetus was given by the Chief Alkali Inspector who proposed a provisional target dust burden in the emitted gases of 0·2 grains per cu. ft.; or just one-half of the dust burden commonly accepted at the time the majority of these stations were designed. To achieve this performance on a typical chain grate boiler of the period means raising the grit arresting plant efficiency to 70 per cent or more dependent on the quality of the fuel.

At a number of stations conversion to oil-firing has proved a more attractive proposition, technically and financially, than improving the dust arrestors. The oil to be burnt is mainly a distillate of low sulphur content so that in addition to a virtual elimination of solid emission, there will also, in these cases, be a substantial reduction in the emission of sulphur dioxide.

The main emphasis of these improvements has been to reduce the emission of dust and grit as being the major cause of complaint, but, where necessary, other measures have been adopted to improve instrumentation, to reduce dark smoke emission or to increase the effectiveness of the chimneys. In some of the latter cases a number of short individual stacks are to be demolished and replaced by a single tall chimney.

Together with similar improvements at some of the medium sized stations in the next category, this whole programme of modernization is to cost about £11m. over a period of two or three years and will secure a material improvement in the emissions from that class of station which has always attracted a disproportionate share of complaint and censure.

The Medium Sized Power Stations

These comprise a large number of plants in all parts of the country with capacities generally in the range of 120 MW to 360 MW. Many were built to designs formulated by the private and public power companies prior to

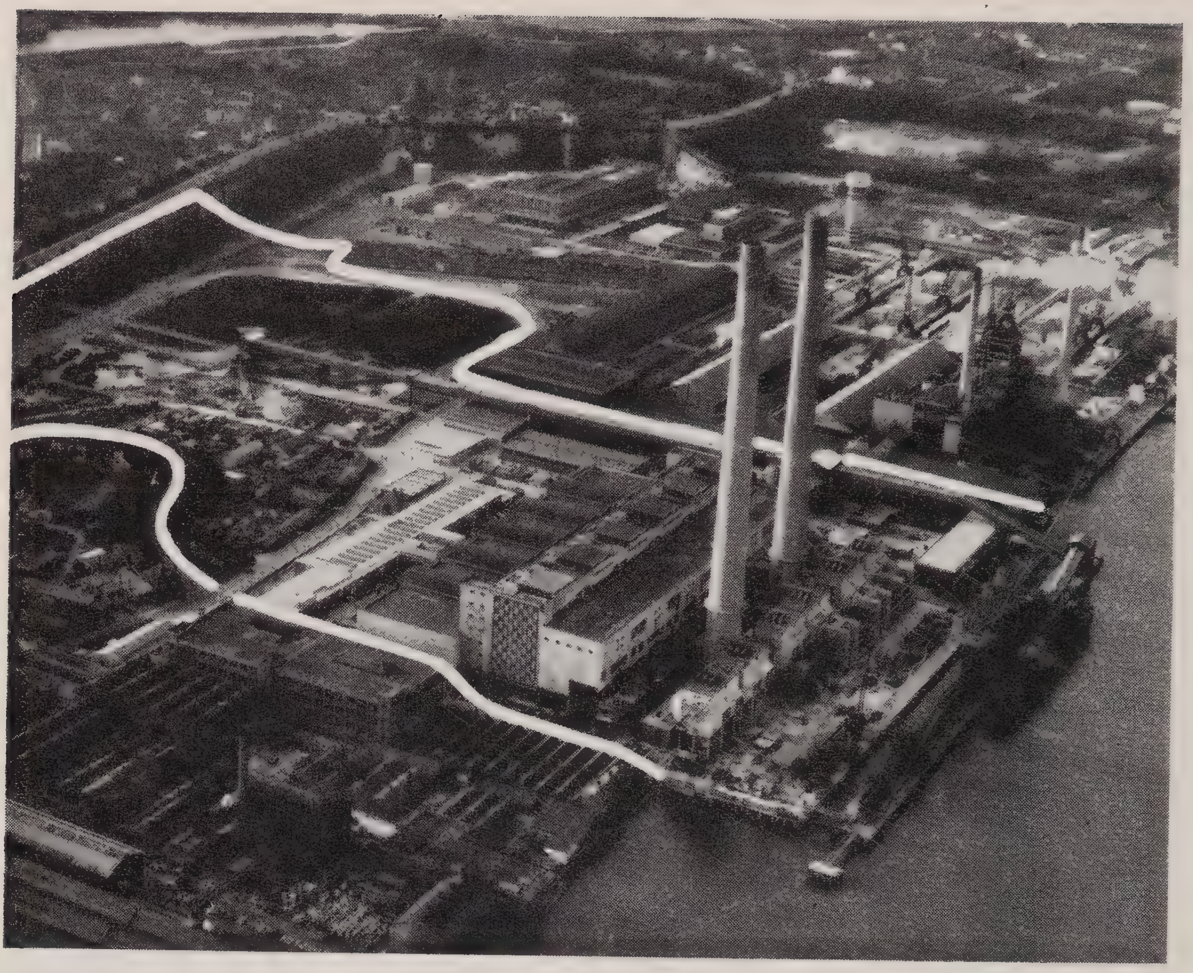

Fig. 5. The 720 MW Power Station at Northfleet on the Thames Estuary. (The site boundary is indicated by the white line)

nationalization and some were taken over in various stages of construction by the then British Electricity Authority. As a result a certain degree of variation exists in the standards of the plant provided to control chimney emissions.

On the whole, however, the arrestor plant and chimneys provided are adequate to ensure an acceptable standard of emissions as long as care is taken to maintain the plant at its optimum performance. Supervision and maintenance are, in fact, the key problems with this class of plant.

In contrast to the small old power stations where, in the main, improvements are a straightforward engineering task, the problems with the medium sized stations have sometimes required the assistance of research to ascertain the cause of trouble and to point the way to their solutions.

The immediate post-war years were a period of great activity in the field of arrestor design with many different approaches to the achievement of high efficiency being developed and tested. Not all of these were equally successful; an instance being the tubular type of precipitator now abandoned in favour of the plate type.

However, a number of plants were built with the earlier designs of arrestor. Almost all were able to achieve their design efficiency on test, but some found difficulty in maintaining it over prolonged periods of operation. Electrostatic precipitators have, therefore, been the subject of extensive research over many years, not only in regard to the basic principles of design, but also to determine optimum operating procedures.

In addition, research has assisted by the development of instruments which can monitor the dust emission from the chimney and detect a deterioration in arrestor performance, which otherwise could only be ascertained by frequent laborious multipoint sampling tests on standard lines (Ref. 2). It is the Generating Board's ultimate intention to monitor continuously every power station chimney, both for dust and for dark smoke (using for the latter a recording photoelectric type instrument).

The Large Modern Stations

This category includes the stations of up to 1,000 MW capacity which have come into full operation in the last few years; a number of stations of 1,000 MW to 1,500 MW ultimate capacity which are nearing their completion dates; and the stations of about 2,000 MW ultimate capacity due to commission in 1965 and later. Six of the latter are under construction and the consent of the Minister of Power is currently awaited in respect of a further two. Having regard to both the past history of technical advances in the electricity supply industry and the probable future growth of electricity demand, there is no reason to suppose that even these stations represent the ultimate in power station size.

Fig. 5 is an aerial view of the 720 MW power station at Northfleet on the Thames Estuary, and is a typical example of a recently constructed power station. The two chimneys are 500 ft. high and at the time the photograph was taken about one-half of the station was completed and in operation. Fig. 6 shows a model of the 2,000 MW oil-fired power station at Fawley, on Southampton Water, now under construction. The single chimney will be 650 ft. high and will contain separate flues for each of the four boilers in order to maintain a high efflux velocity when the station is only partially on load.

The key problem with this class of station is that of scale; of ensuring that the clean air measures adopted are commensurate with the size of the emitting source. It is here that the general principles pioneered by the Generating Board, referred to previously, are attaining full fruition so that coal consumption of the order of 20,000 tons per day at a single station can be planned in the confidence that the resultant effects at ground-level will be no greater than those of smaller stations which have operated successfully for many years.

The basis of this confidence is threefold. Firstly, there is the accumulated experience of operating the largest integrated electricity supply system in the world; secondly, there are the results of considerable research and experimentation in the field of

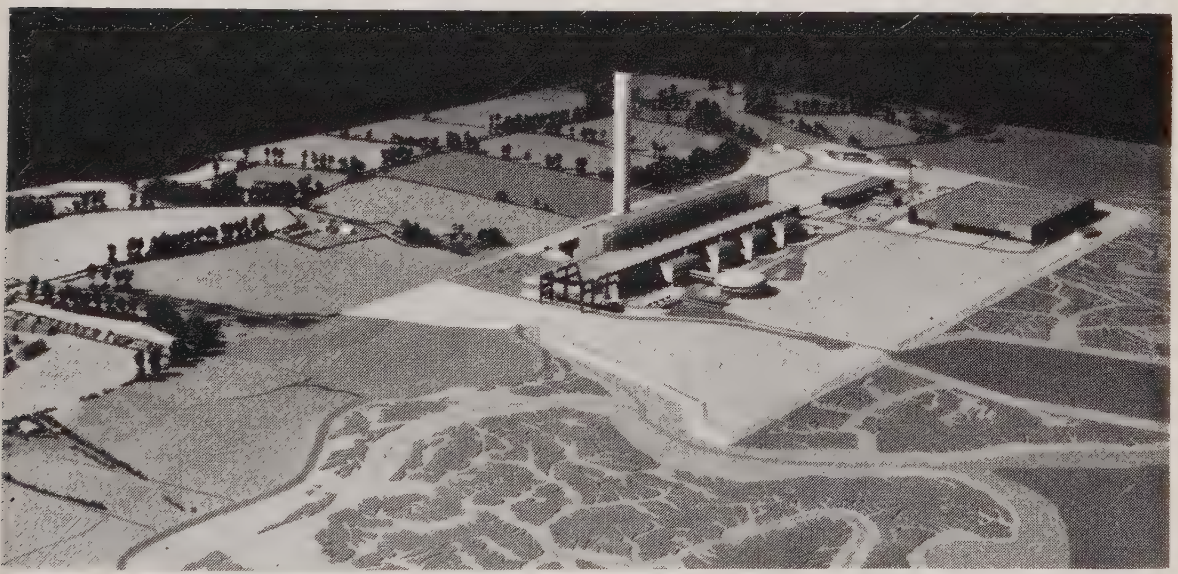

Fig. 6. A model of the 2,000 MW Power Station now under construction at Fawley, on Southampton Water

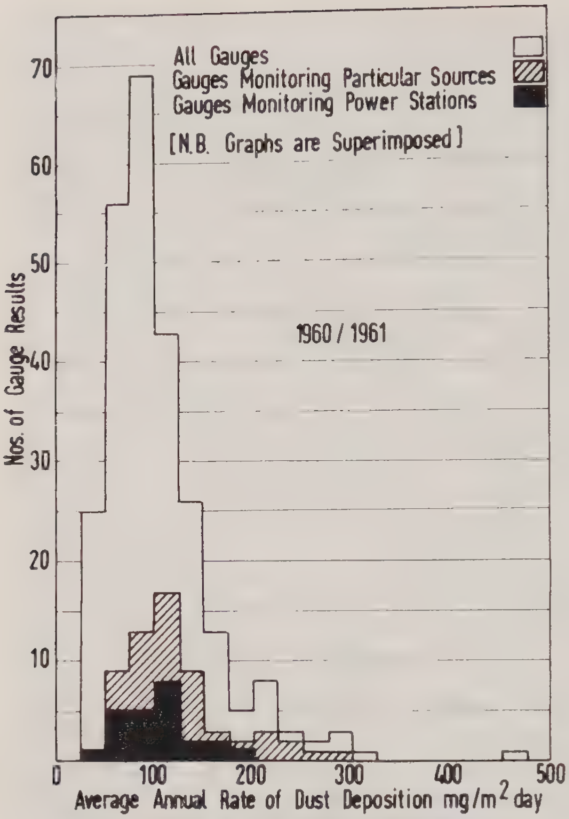

FIG. 1 AREAS OF LOW DENSITY HOUSING

chimney emissions, and, thirdly, there is the use of internationally recognized methods of theoretical calculation. These three factors are used to augment and support each other so that reliance does not, for instance, have to be placed on theoretical calculations alone when predicting the performance of a new station. In view of the concern which is expressed at times about emissions from the very large stations, it is perhaps worthwhile enlarging on these factors.

(*a*) *Practical Experience*

Practical experience has, of course, been gained mainly on the small to medium sized stations discussed above and is too voluminous to permit more than a very general review here. With power stations, as in other fields of human endeavour, most attention and publicity is attracted by the cases where there has been a failure to maintain a satisfactory standard. This can sometimes obscure the fact that the large majority of power stations operate satisfactorily without giving any reasonable grounds for complaint, as it is hoped the following examples will show.

Dust deposit gauges and lead dioxide candles are maintained by the C.E.G.B. around a large number of power station sites and the monthly results from these gauges are supplied to and published by the D.S.I.R., together with readings from similar gauges maintained by other authorities. Figures 1 to 4 show some results of an analysis of the recently published dust deposition figures for the year ending 31 March, 1961 (Ref. 3). The published coding for each gauge site has enabled the results to be separated into different classes of area (such as open country, areas of dense old-fashioned housing, etc.) and further sub-divided

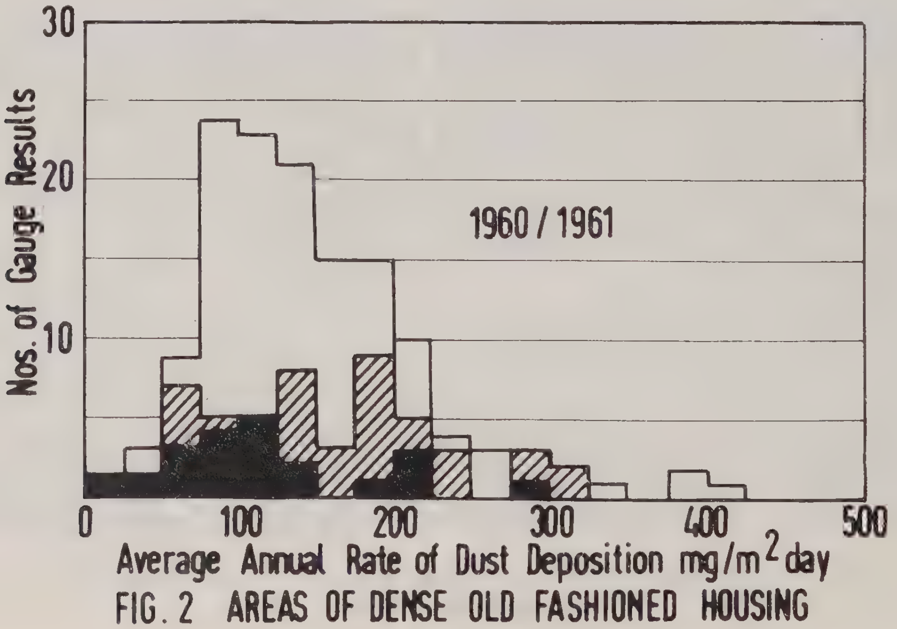

FIG. 2 AREAS OF DENSE OLD FASHIONED HOUSING

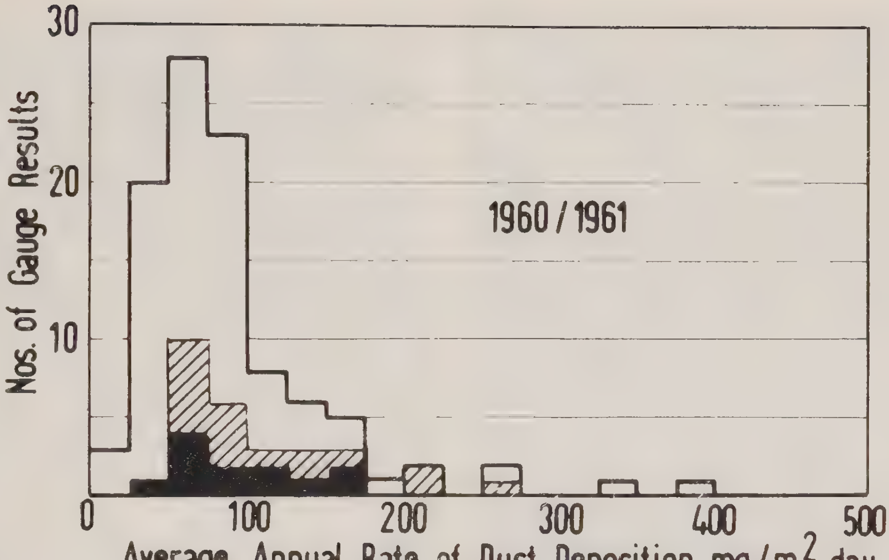

FIG. 3 OUTSKIRTS OF TOWNS

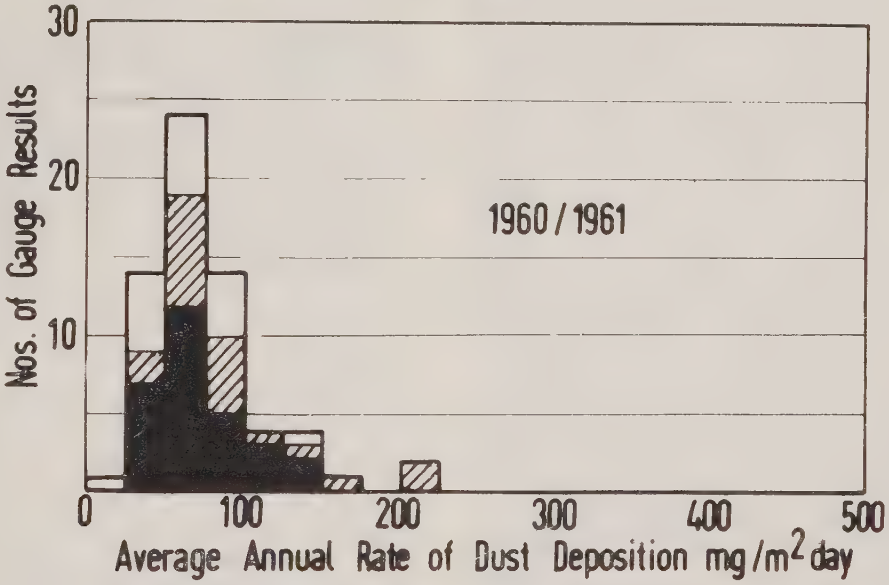

FIG. 4 OPEN COUNTRY

into those gauges which are sited to catch the general deposit in an area, and those which are sited to monitor a particular source of emission (almost invariably industrial). Among the latter will be the C.E.G.B. gauges monitoring power stations.

Some of the conclusions that can be drawn from these Figures are interesting and perhaps surprising. One obvious point is the extent of the overlap in the range of dust deposition rates for different classes of area. In the extreme, gauges measuring general deposit in the open country can sometimes produce higher readings than gauges monitoring particular industries in areas of dense housing.

However, the conclusion of most interest to the C.E.G.B. is that the distribution of gauge results from around power stations closely follows the distribution of all gauge readings in a particular class of area; a result which clearly would not have been obtained if, as a general rule, the emission from power stations materially altered the dust deposition rates of the areas in which they are situated. In other words, dust gauges in these locations would probably have recorded much the same range of dust deposition figures if the power stations had not been there. Since the results depicted include those of 86 gauges around 24 power stations of varying size and age, the generality of the conclusion seems reasonable.

As the coding of lead dioxide instrument sites has not yet been published, it was not possible to make a similar analysis of sulphur dioxide measurements around power stations. From a cursory examination of the readings of these gauges, however, it is expected that a broadly similar pattern would emerge.

A second illustration of the general effect of power stations on the air pollution levels in their neighbourhood can be obtained from a rather different analysis of the same dust and sulphur dioxide gauge results. It has been the Board's practice for some years to commence dust and SO_2 measurements around power station sites some two years before the station comes into operation and to continue the readings for at least two years after the station is complete. There are now 16 surveys where an adequate number of readings are available for a comparison to be made of the mean dust deposition rates for the two-year periods "before" and "after" the station's construction and these are summarized in Table 2. A similar analysis of 16 sulphur dioxide surveys is given in Table 3.

TABLE 2

Comparison of two-year periods before and after construction of a power station

DUST DEPOSITION RATE (STANDARD GAUGE)

Change in mean dust deposition rate mg/m^2/day	*Number of surveys within range*
−20 to −11	1
−10 to 0	3
0 to +10	5
+11 to +20	3
+21 to +30	4
	16

TABLE 3

Comparison of two-year periods before and after construction of a power station

SULPHATION RATE (LEAD DIOXIDE METHOD)

Change in mean sulphation rate mg/SO_2/100 cm^2/day	*Number of surveys within range*
−0·25 to 0	6
0 to +0·25	8
+0·26 to +0·50	1
+0·51 to +0·75	1
	16

The relatively large number of cases where the establishment of a power station has coincided with an improvement in the air pollution levels in its locality (as shown by negative changes in Tables 2 and 3) is of considerable interest but it is not the author's intention to claim a causal relationship! The standard dust deposit gauge and lead dioxide instrument are, of course, non-directional and non-specific so that their readings reflect the overall change in pollution from all sources of emission in the neighbourhood. It can be concluded from these results, therefore, that, even when taking the average of a number of gauges over a period of two years, changes of at least ±20 mg./m^2/day in dust deposition and ±0·25 mg. SO_2/100 cm^2/day in sulphation rate can occur as a result of changes in "background" pollution. Twelve of the 16 power station dust surveys and 14 of the 16 SO_2 surveys fall within these ranges of uncertainty, implying that the standard monthly air pollution gauges were unable to detect any change in local pollution levels resulting from the establishment of these stations against the secular changes in background levels. In the few remaining cases where a larger increase has occurred, part of the change may be due to the power station but in any case the magnitude of the increase is small (as may be seen by comparing the figures in Table 2 with the normal range of dust deposition rates in Figures 1 to 4).

The conclusions derived above from the monthly dust and SO_2 gauge results are admittedly broad and generalized but the limitations of these gauges do not encourage a more sophisticated approach. They serve, however, to confirm that power stations as a rule do not materially increase the pollution levels in their neighbourhood. In respect of dust deposition they also confirm that the favourable results of the intensive survey made some years ago around Little Barford power station (Ref. 4) were by no means exceptional but were, in fact, typical of power station operation.

Such results are, of course, most encouraging since they are derived from earlier applications of the same principles which govern power station design today. However, the power station designer is usually faced with the task of planning a station of much greater size than any on which practical experience has been gained, and extrapolation of *ad hoc* operating results must be made with caution.

(*b*) *Research*

To supplement operating experience, therefore, it is necessary to acquire a basic understanding of the many factors which influence a power station's emissions, both within the station and in the free atmosphere, and this has been the aim of much of the Board's clean air research.

Foremost comes the study of chimney plume behaviour including the rise of the plume due to its velocity of emission and thermal buoyancy, and the subsequent diffusion of the lower part of the plume back to ground-level. Both subjects represent most difficult theoretical problems because of the very large number of factors involved, many of which are subject to variation over a wide range of values. Empirical data gained by actual observation and measurement, therefore, constitute an essential step towards a full understanding of the physical processes involved in plume dispersal.

One aspect of this work has been devoted to the study of plume behaviour at times of fog when there is rightly most public anxiety about air pollution. At such times when low-level emissions from houses, industrial plants and cars are being trapped, the tall chimney is making its most effective contribution. Calculations suggested that power station plumes should be able to penetrate quite extensive stable layers in the atmosphere (Ref. 13). The validity of these calculations was tested by carrying out observations from an aircraft flown over London during a period of prolonged fog in 1958. The final conclusion drawn was that power station plumes will normally penetrate the fog layer which may exist over large towns. Further work suggests that plumes may then experience stable layers of such thickness that they will not completely escape but will penetrate sufficiently far into the stable layer to avoid the possibility of adding contamination to the ground-level fog (Ref. 16).

It was recognized many years ago that new research techniques, and instruments of greater sensitivity than any then available, would be required if worthwhile results were to be achieved from a study of power station emissions, and considerable effort has been devoted to developing the necessary research tools. From this work has emerged continuous SO_2 meters in a variety of forms (Ref. 5), directional dust deposit gauges, flue dust monitors (Ref. 6), balloon tracking techniques for measuring plume rise (Ref. 7), photo-microscopic techniques for identifying dust (Ref. 8) and new methods for the size grading of dust (Ref. 9).

Studies of plume dispersion have been made mainly by using the SO_2 content of the gases as a tracer. After a number of rapid SO_2 surveys at a variety of stations (Ref. 10), a comprehensive investigation was conducted in 1958 at Castle Donington power station, then the largest station in full operation. In the course of 10 days' observations, over 2,000 three-minute average readings of SO_2 concentrations and about 300 measurements of plume rise were obtained.

The results of this work, and the detailed analysis that has been made of the records obtained, are shortly to be published.

With the experience gained on this survey, an even larger investigation was planned and this has now commenced at Tilbury. This will include continuous measurements of sulphur dioxide concentration at a pattern of 22 points at ground-level; continuous measurements of plume rise by means of a modified cloud searchlight; and the recording of a comprehensive range of meteorological parameters at various heights above ground-level. The voluminous data obtained will, of necessity, be analysed by digital computer.

Research projects on this scale are, of course, expensive (this survey alone will cost over £50,000), but the data derived from them will be of vital importance in the design of future power stations, perhaps of larger size than any yet planned.

Amongst other clean air research being conducted by the Generating Board is the continued search for technically satisfactory methods of removing sulphur from fuel and sulphur dioxide from flue gases. Of the former it cannot yet be said that there is any sign of a real breakthrough, but in the latter case there are some grounds for cautious optimism. Dry sorption processes using either activated carbon or alkalized alumina are beginning to appear at least technically feasible, but work has not progressed far enough for any useful estimates to be made of either the efficiency or the costs of a full-scale installation. It is reasonable to assume, however, that the cost will be high so that a SO_2 removal process, if one is developed, will probably be justifiable only in those cases where other measures are inadequate to deal with the problem.

In addition to practical research work, a number of theoretical studies on various aspects of air pollution and chimney emissions have been published by C.E.G.B. staff (Refs. 11-14).

(*c*) *Theoretical Calculations*

The use of theoretical calculations for predicting the effect of future power stations requires the exercise of considerable judgment. A glance at any comprehensive clean air bibliography reveals a bewildering number of theoretical solutions to the problem of calculating plume dispersal, each with its attendant formulae of greater or lesser complexity. These can all give different (sometimes substantially different) results when applied to a specific case. Clearly, they cannot all be correct, and, in the course of time, practical knowledge gained from research and operating experience will weed out the unsatisfactory ones.

Until then the safest use of theoretical formulae is as a means of comparing one source of emissions with another, with only limited credence being given to the absolute values of SO_2 concentration or dust deposition so calculated. Used in this way, the formulae enable the probable effect of a new station to be compared with the known effect of an existing station; or the effect of altering design parameters, such as chimney height, to be explored.

For such purposes, it is suggested that complex diffusion equations are not always necessary since, for many purposes, a number of the variables involved, particularly the meteorological variables, can be taken as common to the cases under comparison. The only important factors which then need to be considered are the rate of emission of the pollutant (Q) and the effective height of the source (H) which, if related, in the form $\frac{Q}{H^2}$ give a measure of the resultant effects at ground-level. The validity of this relationship is widely accepted in all the authoritative works on atmospheric diffusion and it can thus be taken as an index of emission performance, without all the qualifications which are necessary when absolute figures are calculated.

To illustrate this approach, Table 4 gives values with the factor $\frac{Q}{H^2}$ for

TABLE 4

Values of $\frac{Q}{H^2}$ for SO_2 Emissions from Selected Power Stations

Station	*Capacity*	*Rate of SO_2 Emission (Q) lb/hr.*	*Effective Height of Emission (H) ft.*	$\frac{Q}{H^2} \times 10^3$
Bold 'A' . .	128	4,600	530	16·4
Drakelow 'A' . .	244	6,400	670	14·3
Ferrybridge 'B'. .	300	10,400	960	11·3
Blyth 'A' . .	480	15,200	850	21·0
Northfleet . .	720	18,400	1,040	17·0
High Marnham	1,000	18,200	1,100	15·1
Eggborough . .	2,000	63,500	1,970	16·4

the SO_2 emissions from a range of power stations of different sizes. In this instance, the effective height of emission has been calculated by a method proposed by Bosanquet (Ref. 15) and a numerical factor of 10^3 has been introduced to give convenient figures of $\frac{Q}{H^2}$. (The Board's research on plume rise suggests that, in practice, Bosanquet's method of calculation gives conservative results; the actual observed plume rise from stacks serving up to 400 MW of plant has been appreciably greater than the calculated figures.)

A similar set of figures could, of course, be calculated for dust emissions, when the value of Q would take into account the dust arrestor efficiency. In this case, however, a straightforward comparison would be possible only if the size grading of the emitted dust was reasonably similar in all cases.

It will be seen from Table 4 that with adequate attention to the design of chimneys, a fifteen-fold increase in power station size can be accomplished without any corresponding upward trend in the effects of the SO_2 emissions at ground-level. Relating these figures to actual operating experience: Drakelow "A" is one of the eight cases listed in Table 3 where there has been a very slight increase in mean SO_2 concentration since the station commenced operation, whereas Ferrybridge "B", Blyth "A" and High Marnham are among the six cases where there has been a slight decrease.

A combination of practical experience, research and the simplified use of theoretical calculations thus leads to a considerable measure of confidence that emissions from the large power stations now being planned or constructed will not result in any material increase in the local air pollution levels.

Conclusions

In summary, therefore, the C.E.G.B's current activities regarding emissions from power stations include a substantial programme of major improvements to the older plant; the continued search for better operating and maintenance procedures for the plant of medium age; and the designing of new plant along established and well-proved paths.

The question may arise as to the more distant prospects when the continued rise in demand for electricity and the dictates of economy and amenity will undoubtedly point to the need for even larger stations than have so far been planned. In the design of such stations no immediate departure from the principles already discussed is envisaged. At some future point, however, the law of diminishing returns may well operate to the extent that further increases in stack height and capacity may no longer compensate for the increased fuel consumption. At this stage a new technique may be required, and it is in anticipation of this situation that research on various alternative ways of limiting SO_2 emission to the atmosphere is being pursued. Currently, one of the most important tasks for research is determining the largest size of plant that can rely upon tall stacks and thermal buoyancy for adequate dispersal; whether this limiting size will be 4,000 MW, 8,000 MW or even more, remains to be determined.

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APPLICATION AND PERFORMANCE OF ELECTRICAL OFF-PEAK SPACE-HEATING IN BUILDINGS

by

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THERE is no need to make any attempt to disprove that the utilization of electricity for heating leads to pollution of the atmosphere; at the present time however there is not enough available, at least at certain times, and the price is higher than for other forms of energy.

Electricity used directly for heating is very convenient, but it does make high demands on the supply industry often at the same time as the industrial demand, so it has therefore been the concern of the industry over a considerable number of years, through ourselves, the Electrical Research Association, and other suitable organizations, to study and improve the application of off-peak storage heating by electricity since this can be offered more cheaply during certain hours when it is not required for other purposes.

Most research effort up to the present has been devoted to methods of thermal storage heating, which rely on what we know as the specific heat of materials, that is, the material is heated up to a high temperature and allowed to cool down. For sufficient thermal storage capacity it is necessary to have either a large amount of heavy material and a reasonable temperature rise, or less material and a higher temperature rise. Suitable materials for this kind of storage include concrete, magnesite, marble, steel, bitumen, etc., all having specific heats between 0·2 and 0·3. Research effort is devoted to determining how much material is really wanted for certain duties; the best way to shape it; the best place to put it; how it should be installed, and so on, in order to control the rate at which the heat comes out.

New work on thermal storage starts by enquiring whether there is any way in which other physical phenomena can be used to reduce weight or bulk. Some chemical substances melt at a useful temperature, absorbing latent heat to do so, and while they are solidifying the heat is given out again. Off-peak heat can be used for the melting process and a cyclic performance consists of melting and solidifying at the appropriate rate, a much smaller quantity of material being needed than for the specific heat method, since the heat exchanged per pound for melting and solidifying is much greater.

Storage by straight specific heat methods, i.e. heating up and cooling down over a range of temperatures has been applied in two ways. The fabric of buildings has been used; this can be the walls or the ceiling, but the floor is often the most convenient. Here the concept of a large mass of material and a low temperature rise is used, since one has to accept a certain floor surface temperature as a boundary condition, and so one is limited by this temperature to a fixed temperature range. It is very fortunate that in many cases the ordinary structure of a concrete floor—with perhaps some small variations in thickness in different parts—does lend itself extremely well to just about the right amount of storage that is needed in an enclosure of which it forms the floor. One therefore starts with something which works pretty well by itself and only details need study. This first method is difficult however when thermal storage is required in existing buildings, and the idea of a smaller quantity of material at a higher temperature must be resorted to, i.e. the block heater. Again there is some limitation of surface temperature, because children may touch it, but blocks of convenient size can be designed to give out heat at a desirable rate, although it is necessary to insulate the surface to prevent heat coming out too quickly. The thickness of insulation used is only about half-an-inch for the uncontrolled block heater, in which all the heat comes out through the surface. The element temperature is about 1400°F and the average block temperature during the day is probably about 500°F and the surface about 200°F. This type of block heater has been made controllable by providing internal air passages in the block and a fan. Thicker insulation is applied round the block so that only a small proportion of heat leaks through the surface. The block can be charged with heat in the night off-peak period in the ordinary way and only a very small quantity of on-peak electricity is needed to operate the fan during the day. The fan can be connected so that it is operated by a room thermostat and/or another time switch, and the heat can come out all day, varying according to the demand for heat; alternatively the operation of the fan can be postponed until evening. Only a small quantity of heat—providing rather low-level background heating—will be given out during the day.

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The use of electric floor heating has spread over so many types of building now that much attention is being paid to possible variations in tolerable floor surface temperatures in different circumstances. The Medical Research Council has shown that, although 10 per cent of people do not mind floor temperatures above 90°F and only 10 per cent of people find above 84°F objectionable, nobody at all minds 77°F or below. The surface of a continuously-operated floor-heating system should not, therefore, rise above 77°F. With off-peak floor-warming, however, the floor surface temperature is going to vary, so that if it starts at 77°F it will be below that by the end of the day. It was, however, observed in the medical experiments that, provided the temperature was falling, floor surface temperatures up to 86°F were tolerated for periods of about 30 minutes. It has now been accepted that, if necessary, a floor surface temperature can rise to 86°F at the beginning of the cooling period—as long as the average temperature during the day is 77°F or less.

Preliminary Assessment

In order to ensure that a floor-heating system is not installed in a building for which it is unsuitable or inadequate, a preliminary assessment of the necessary floor surface temperature to provide the required air temperature should be made. The heat transfer coefficient, the amount of heat per square foot that is given out for every degree difference between the floor and the air is just about 0·5 watt per square foot. This sets a limit to the amount of heat which can be provided by a floor which cannot be allowed to rise, say, above 80°F, and if this is not sufficient to offset the heat loss of the room, floor-heating alone will not be adequate. Several things can be done about it. One can give up the idea altogether; one can insulate the building and reduce the heat losses to within the required amount; or one can use the system for background heating only, which means a lower air temperature but the same floor surface limitation still applies.

Sometimes confusion arises between the total amount of heat that actually comes out of the floor because the floor is warm, and the amount of electrical energy or hot water energy which has to be put into the floor to make it work. Obviously one must put heat in at a higher rate in an off-peak heating system, because there are only a certain number of hours in the day available during which the total amount of heat needed for the rest of the day must be absorbed and the losses during the heat-up period must also be supplied. In general, therefore, if one has got 12 hours to put the heat in then it must be put in at the rate of H x 24/12, where H is the rate of heat loss for the design temperature rise. On this point one has got to be a bit careful in considering the variation in tariffs which are available now. Research is being done to find out what variation will have to be applied to the floor structure to enable full-comfort heating to be obtained with an off-peak period of only 8 hours, 11 p.m.—7 a.m. It is not, of course, only the installed electrical capacity which should be considered but also the effect of the thickness of the floor. If enough electrical loading is installed the temperature can be increased at almost any desired rate. The rate of cooling cannot be reduced except by increasing the storage capacity or the insulation of the room. Buildings of heavy construction will themselves provide quite a lot of natural storage and the well-insulated building will not cool so fast, obviously, as the lightly-insulated building. It is, in fact, possible to calculate fairly closely, from an expression derived by Mr. Danter of the Building Research Station, the maximum rate of cooling of the air in a floor-heated building. If a floor-heating system will give a fall of air temperature not greater than 6°F, say from 68°F to 62°F over the whole day, then it is suggested that it can be accepted. The calculated fall, in practice, only occurs very rarely with normal buildings—in fact, it is quite difficult to find days in which there is any appreciable cooling in some buildings at all. On the other hand the calculation indicates that with some single-glazed, very lightly built, top floors this cooling swing of air temperature might be 14°F or more. In a case such as the latter increased insulation or more storage in the floor should be considered.

As was stated earlier, the right amount of material must be available for adequate storage and the correct part of it must be used. Experiment has shown that the thickness of concrete over the top of the cables is the part that does most of the work. It would be no good only having an inch of concrete over the cables and six feet below. What is needed is three inches above the cables, if possible; this can be increased to four inches with advantage, but above four inches the floor begins to be unresponsive to changes in the weather conditions quickly enough. If the thickness above the cables is less than two-and-a-half inches in all but very well-insulated buildings, the room will cool too fast.

Ground Floors

When ground floors are heated a certain proportion of the heat goes downwards. With no insulation below the cables this proportion is some 30 per cent on small floors and somewhat less in proportion on large floors. It can be worse than this on wet sites, so that on such sites it is always desirable to put a layer of insulation equal to at least one inch of expanded rubber below the cables, preferably below the slab. Two inches of expanded rubber is somewhat better than one, but not twice as good, but there is one advantage to using expanded rubber for this purpose: it will double for the damp-proof course if it is properly put in, so that any extra expense is not so great as would appear at first sight. In small rooms, it is sufficient (except on wet sites again) only to turn the insulation down the edge of the screed and turn it in for about two feet. On large floors on dry sites, it is a little doubtful at the moment as to what one should do and there is some experimental work going on on this. One mathematical approach suggests that on large floors the insulation still only needs to be turned in two feet underneath, and this may very well be right. On the other hand, there may be a little more advantage than one thinks in insulating—even on a dry site—under the whole of the floor. It is a question of economic justification on the cost, of course, but in any case one should always insulate round the edge and turn it under. This is particularly true if, in domestic buildings or office buildings, insulating floor coverings, such as carpets, are to be used. It is not so serious in workshop or factory buildings, or even floors (for instance in schools) where there are only Marley tiles or linoleum surface, except again on wet sites.

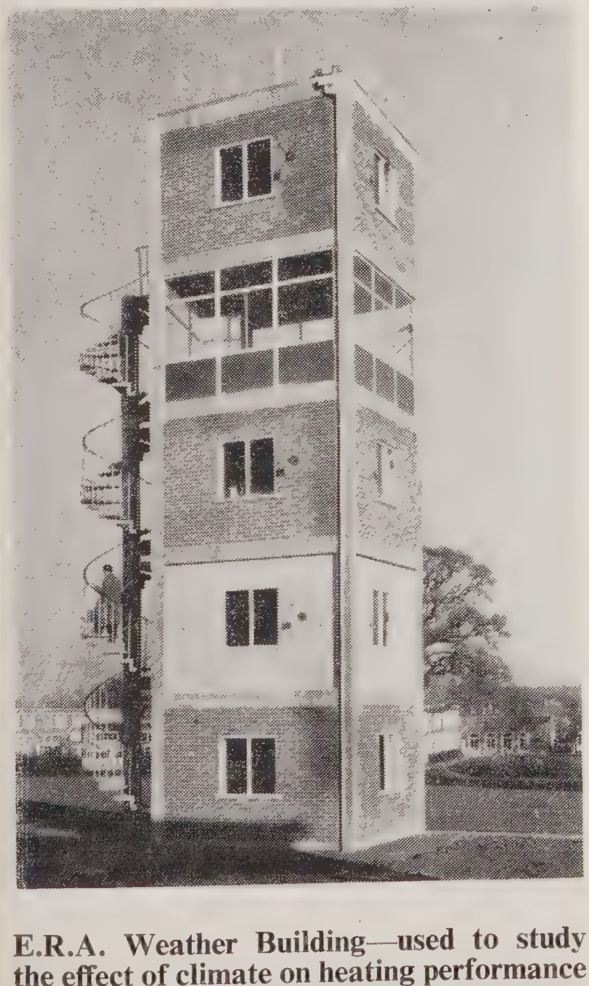
Multi-Storey Buildings

In multi-storey buildings another problem is involved because the heat that goes down through suspended floors may be going to heat up someone else who is not paying for it. This is particularly awkward on top floors, since the tenant on the top floor does not get a contribution from anyone up above. Again it is more serious if carpets and underlays and woodblock floors, and so on, are going to be used, but in a domestic building it should be assumed that these will exist, and the question of thermal insulation seriously considered. This insulation will do two things; as long as it is below the cables, and is present in the right amount, it will reduce the proportion of heat going downwards; it will also alter the effective storage in the floor, and hence the rate of cooling of the air and floor temperatures, according to its position. With no insulation in the floor at all and with a thick carpet on top, possibly only 30 per cent of the heat comes up and 70 per cent goes down; the result is perfectly good ceiling heating and, in fact, this arrangement gives the slowest rate of fall of air temperature in the room, everything else being equal. On the other hand, if floor-heating, rather than ceiling heating, is required, with perhaps only 10 to 20 per cent of the input heat coming downwards from the ceiling, the slowest rate of fall of air temperature is obtained with, say, 2 inches of insulation on the soffit. This fall is much slower than that observed when the same amount of insulation is placed directly below the cables, that is, for the same screed thickness. If only acoustic insulation is placed directly below the cables it will not stop the heat going downwards so effectively, since it is usually only 0·5 in. thick. Unfortunately the two arrangements of soffit and thin acoustic insulation cannot be combined without sacrificing storage efficiency. If acoustic insulation must be used, the best thing to do is to thicken it up to 2 inches, but at the same time to remember that three inches of screed at least is needed and, if possible, four inches.

On the other hand, when a carpet is used the concrete will have to rise to a higher temperature to get the heat through the carpet. This means an increase of storage assuming that the electrical loading is sufficient to maintain the required surface temperature. The carpet still pushes more heat downwards, unless this is prevented by insulation below the cables.

Because the screed temperature is increased with carpeted or insulated floors, it is very important in these circumstances to ensure that the edge of the floor is insulated. It is also important to be sure that wood flooring is made of hard wood if carpets are to be put on top, because it will get rather hot. Another point that has needed a great deal of consideration from the technical point of view is the increase in temperature of the cable sheath when carpets are used. Many of the faults that have arisen in the past have been caused because, for the sake of economy, people have tended to use the shortest length of cable possible and this then runs much too hot, unless special materials are used for the sheath. All the cheap embedded systems are based on a simple P.V.C.

cable and this cable is perfectly adequate, even with carpets, provided that this type of economy is not attempted. Some of the original cables were only 2 watts per foot length, giving about two-inch spacings, up to, say, 4 watts a foot length, and those cables have given very little trouble indeed, simply because they are running well below their maximum working temperature, even when the floor is shrouded with carpets and underlays, and even when (due to conditions which sometimes cannot be controlled) small voids exist in the floor round the cables. A highly-loaded cable will tend to get very hot in a void, and a good deal of the faults that have arisen—the odd ones that were not due to carelessness in installation—have been because cables have become hot in such voids, and have been able to expand and break. New materials for the cable sheaths are being developed, but simple precautions should avoid most of the trouble.



E.R.A. Weather Building—used to study the effect of climate on heating performance in rooms of different constructions

Test Room and Buildings

In our laboratory we have a test room round which we can keep the outside temperature at freezing point all the year round. We can therefore study the performance of any system or the effect of insulation on storage, for example, under the worst conditions, and we do not have to wait for cold days; we can also keep the conditions constant. We also have two buildings, the walls of which can be varied from lightweight to heavyweight and in which we can do floor-heating or any form of electrical heating, and compare them, so that we get exactly the same conditions for two different types of heating in natural outside conditions. For example, we have made an absolutely simple comparison of office heating by direct tubular heaters and by off-peak floor warming, so that we obtained one figure which was the ratio of consumption to provide the same conditions by off-peak floor-warming and by direct heating for a season. Now we are testing controllable and uncontrolled block heaters in a similar way.

There are already available many ingenious devices which get very close to anticipatory control of off-peak heating systems. But if one could arrange with the Meteorological Office to transmit the weather forecast by means of a code through the Post Office telephone lines, for example, one could, by means of automatic relays, adjust the number of hours of heating (it would probably only be worthwhile for big buildings), in direct relationship to what the weather was going to be the next day. What is not known, exactly, is how many hours less one would need if one knew the temperature was going to rise 10°F, say, or if it was going to be a very sunny day or, alternatively, a cloudy day; or how many extra hours would be required if it was going to be very windy or if there was going to be rain.

The effects of all these things may be different for different types of building, so a special structure has been built which has three cavity-brick rooms, ground, top floor and middle; it has one single-glazed room which can be altered to double-glazing, and a very highly-insulated lightweight concrete room. The changes in heat loss of the building for different weather conditions is being studied very carefully so that the necessary heat input can be estimated to combat future changes in heat loss.

One thing that often leads to confusion in discussions on floor-warming and other forms of storage heating is the effect of ventilation. It is quite true, of course, that floor-warming itself does not need a high rate of air change to make it work, but in any design of floor warming the recommended air changes should always be used. That is, if two air changes are needed during the day, the amount of heat required from the system should be designed to take account of this. On the other hand, if one is estimating what the consumption is going to be, one is entitled to take advantage of the point that at night, with the windows closed, the ventilation will probably be only half an air change, so that over the whole day there is only an average of one air change. It does not mean that one runs the floor-heating system without ventilation.

Controllable Methods

A form of floor-heating which can be described as controllable is being studied. What is done is to insulate the concrete slab over the whole of the base and the top, and to provide channels in the concrete through which air can be blown in the daytime. The concrete is heated by cables laid either in the channels or embedded in the concrete. The insulation on top is chosen so that there is a certain leakage through the floor surface which is sufficient to keep the chill off the room, but during the day full heating can be obtained by blowing or pushing air through the floor by means of a fan, the air either entering or leaving by registers in the wall at the other side of the room. More heat can be stored in the same amount of concrete using this method because it can be much hotter, since the surface is not exposed. It has been shown that if the concrete is heated up for 8 hours, heat can be taken out of it for 16 hours to keep a room at 68°F, the fan being controlled by on-peak electricity, of course, and by room thermostat. On a warm day the fan would not operate very much; on a cold day it might run all the time. But one can heat a room by this method with an 8-hour charge and provide full heating, bringing an average room with two outside cavity brick walls up to full temperature in about 20 minutes.

Free-standing or block storage heaters range from single units of 1–2 kW input to multiple units of 9–15 kW input designed to distribute warm air through ducts. The materials used are such that 1 kWh is stored in one cubic foot for every 100°F rise. The average small room needs about 3 cubic feet at 500°F rise or 15 kWh to provide enough heating on a cold day, and this is the size and capacity of the most common unit available commercially. The maximum temperature of the element is controlled by a thermostat and this can also be used to adjust the output to match a given rate of room heat loss. The type of storage unit which dissipates heat only through the surface keeps rooms rather warmer at night than the type which, as described earlier, loses the majority of its stored heat by forced convection as warm air. In the former case the walls and furniture in the room tend to get warmer from absorbed radiation and the rate of cooling of the room air is reduced. Where it is not desired to provide warm conditions all through the day, but to conserve the stored heat mainly until the evening, the fan-assisted or damper-controlled heaters are preferable. The damper-controlled type is cheaper than the fan-assisted and is not automatically controlled, but it has the same facility of reserving a high proportion of the stored heat until the evening.

The shape of the heat output curve of the uncontrolled block heaters can be varied to give either a high rate of initial heat output for some hours, tailing off rather sharply, or a flatter curve approaching more nearly a uniform rate of heat output. This can be done by varying the position of the element and/or the thermal resistivity of the storage material. Research is being carried out to improve this flexibility of design by detailed studies of the effect of variation of the various parameters concerned.

Other Research

Research is also being carried out on methods of thermal storage which involve the use of materials such as caustic soda and quicklime, which have the potentiality of storing large amounts of heat in a small volume. Caustic soda with suitable mixtures of inhibitors can be rendered completely non-corrosive and can be used, we hope, quite conveniently to store the same amount of heat in something like a quarter of the volume needed for the present type of heater. It should be better than that, but one has got to allow for air spaces and methods of getting the heat out. Present official thinking restricts this method to the larger type of storage heater serving several rooms from a central position. To use lime for storage purposes one starts with the slaked material and off-peak electricity is used to dry it out overnight converting it to quicklime. The heat can then be obtained during the day by letting water vapour come in to percolate gently through the lime. Of course, a means has to be provided for passing the room air through channels or pipes in the lime. This particular idea is promising, and it has the advantage that the heat does not have to come out unless the water is put in and this offers really a higher degree of control.

In general the methods of control used for floor-heating can be applied to the output of free-standing or block storage heaters. Several studies of the efficacy of these controls in promoting economy of consumption have been made and are under analysis.

With present off-peak prices for electricity, and taking account of the relatively low capital outlay involved, thermal storage methods offer a service competitive with any other fuel. To obtain the true benefits of this service, however, particularly in the case of floor-heating, the simple recommendations outlined in this paper must be accepted. Installations properly designed in this way should be part of the architect's thinking from the very outset of a building contract. Where this is the case successful and economic functioning is the result.

Discussion

Dr. Albert Parker (President) in opening the discussion said that five papers had been presented on a variety of topics. They could conveniently be divided, however, into two groups—firstly, the papers by authors from the Warren Spring Laboratory and the Central Electricity Generating Board on the dispersion of pollutants from chimneys and the reduction in the quantities of grit and dust and sulphur dioxide discharged—secondly, papers by authors from the National Coal Board, the Gas Council, and the British Electrical and Allied Industries Research Association on some developments that should lead to the more efficient and less costly use of solid and gaseous fuels and electricity and to a reduction in air pollution. There was no paper specifically on the use of oil.

The investigations on the effects of such factors as height of chimney, velocity and direction of the wind, and the temperature, upward velocity and quantity of the gases discharged, on the dispersion of the gases in the air were important and should add considerably to existing knowledge. Meanwhile, general guidance on desirable heights of chimneys was given in the Memorandum issued in May, 1963, by the Ministry of Housing and Local Government and the Scottish Development Department. He (Dr. Parker) had had to advise in several cases. Though he took into account the results of theoretical studies and practical investigations, he usually found that the height of chimney so derived for a level site with no obstructions, had to be increased by an amount based on experience to take into account the local topography and the effects of nearby buildings.

In the paper from the National Coal Board, Dr. Taylor had outlined the Board's work on solid smokeless fuels, the replacement of miners' concessionary coal in smoke control areas, and the development, in co-operation with manufacturers, of improved appliances for burning solid fuels. He had referred to the specification issued by the British Standards Institution for coke for open fires and the specification in preparation for cokes for closed appliances. The specification for coke for open fires referred to size grading, moisture content, ease of ignition, and radiation characteristics. When this specification was revised, it could be improved by including a limit for ash content.

Mr. Johnson of the Gas Council, in his paper, had given a clear account of the Council's investigations and plans for the storage of large quantities of gas underground so as to increase the load factor of plant for the manufacture of gas and for the production and import of natural gas. Any move in this direction would help to keep down or reduce the price of gas to consumers. There had been considerable experience of underground storage of gas in America and in Europe, but when the Gas Council promoted a Bill in Parliament to obtain power to store gas underground near Winchester, there had been local opposition. That opposition was due to unjustified fears of subsidence and of leakage of gas. There is no risk of subsidence because the gas would be stored in porous strata or aquifers; and with suitable geological formations, which are always first proved by detailed investigation, there would be no risk of leakage. To store the same amount of gas in ordinary overground gas holders as could be stored underground in the aquifer near Winchester would probably require 1,000 holders at a cost in the region of £500 million. It was hoped that there would shortly be a Government Bill on the subject.

In her paper, Miss Griffith of the Electrical Research Association had given a clear description of methods of space-heating in buildings, using electricity at much reduced prices at times when the overall demand for electricity was low, thus improving the load factor at electricity power stations.

G. R. Millington (Horbury U.D.C.) referred to the obvious interest in modern methods of gas storage but felt that the Gas Board had let down local authorities regarding the availability and cost of the smokeless fuels. He had just heard that in his district the price of Gloco was to be increased by 1s. 4d. per cwt. bringing the cost per cwt. up to 11s. "This is far too much for old age pensioners to pay" he said. "If it is possible to provide cheap milk for children and expectant mothers, surely it is possible to provide cheap fuel for pensioners?"

F. F. Ross (Central Electricity Generating Board) said that Mr. Britten the previous day, and the authors of the present paper, seemed to believe that one could get rid of SO_2 from flue gases by laying out enough money. But it was not merely a question of economics. The object was to reduce ground level pollution by SO_2, and there were real technical difficulties. It was true that a new idea currently under investigation offered some hope of reducing the SO_2 in power station flue gases without washing or cooling them, but it meant that large quantities then had to be treated at ground level and converted to something else; this was likely to cause greater pollution of the neighbourhood than dispersal in the upper atmosphere.

We had to accept that both indigenous coal and imported oil contained sulphur, and the aim should be to see that this sulphur was so widely dispersed that nowhere did it reach harmful concentrations. Ten years ago the electricity industry was burning a seventh of the country's coal. The proportion would soon be a third. This was a change from low chimneys to high chimneys, and constituted a great improvement at ground level. "Low chimneys—low sulphur: high sulphur—high chimneys" should be the Society's policy.

P. Draper (Individual Member) commented on the paper "Power Stations and Clean Air" by G. N. Stone and A. J. Clarke. He considered that too little emphasis had been given to what amounted to a major technical breakthrough: a single sentence in the paper read (p. 121) "The single chimney—(of the new Fawley power station)—will be 650 ft. high and will contain separate flues for each of the four boilers in order to maintain a high efflux velocity when the station is only partially on load".

Mr. Draper had been advocating this system for several years as being one of the best methods of preventing smut formation in multi-boiler installations. He said that it was essential, in highly efficient combustion plants, in which the least possible heat is thrown away up the chimney, to keep the flue surfaces as hot as possible in order to eliminate moisture condensation and a "fly paper" carbon build-up effect. This would be achieved as the multiple flues would prevent dilution of the hot gases by cold air from "off load" boilers and, when on part load, the flue gases would be contained by the smallest possible flue surface area thus keeping cooling to a minimum. The other feature of great value, as stated by the authors, would be the high flue gas exit velocities on part loads. Mr. Draper asked if the authors would state the design gas velocities at full and minimum load of any one flue. He hoped that it would be high since that coupled with a reasonably high gas temperature was undoubtedly the best method of dispersal of the vast quantities of flue gases into the upper atmosphere.

In conclusion he referred to hospital chimneys as some heated feelings had been expressed on this subject earlier in the proceedings. Chimney design alone could not prevent the issue of smoke, which was a matter of combustion engineering. This problem was fully understood by engineers and was capable of solution. On the other hand in cases where smuts may be causing trouble in multi-boiler installations a multi-flue chimney was one of the best remedies as had already been appreciated and put into effect by some of the Regional Hospital Board engineers.

Dr. W. C. Turner (Poplar) stated that emphasis on very tall chimneys associated with large fuel burning installations was very important in relation to the average level at which inversions occurred. Frequently, inversions giving rise to quite serious conditions, were under 500 ft., and the chimney which initially penetrated this layer, would enable the effluent gases to rise clear of the accumulated air pollution and, in most cases, thermal lift of the plume would prevent mixing.

With regard to high efflux velocities, however, he thought there was obviously an optimum. Any rate above that would tend to defeat the object of securing "added" height to the chimney. Quite clearly, if the efflux velocity exceeded by a substantial margin the rate of air movement across the top of the shaft, it would very considerably increase the turbulence which would result in the very rapid cooling of the plume, even to the extent of loss of all thermal lift, particularly where effluent gases contained a high water vapour content.

With reference to the materials being used in thermal storage heaters he suggested to Miss Griffith that the physical properties of sodium silicate might lend themselves to study—it was a material with a high capacity for heat retention, inert chemically, non-corrosive, an insulator and even if the temperature were raised above melting point, the vapour pressure would be negligible.

D. J. Heslop (Ministry of Public Building and Works) spoke with reference to the paper by Dr. Reed, Mr. Barrett and Mr. Wallin, and said he had noted that gas velocities in the chimney could be varied up to 100 ft./sec.

He wondered if Dr. Reed could say what he would consider chimney exit velocities should be for two different conditions of oil-fired boilers:

(*a*) Oil burner with forced draught front and natural draught chimney.

(*b*) Oil burner with induced draught front and induced draught fan between boiler and chimney.

Mr. Heslop then told of two different circumstances of chimney conditions which had been the subject of experiments and test during his combustion engineering work on boiler plants in barracks, camps and other Army installations.

The first (*a*) consisted of a rectangular boilerhouse about 100 ft. long by 50 ft. wide and 20 ft. high. Superimposed on this to a total height of 40 feet was a brick tower 15 ft. by 12 ft., housing water tanks and three steel chimneys 30 in. diameter, in line and 4 ft. 6 in. centres. These to conform to architectural requirements only projected two feet above the flat top of the tank room extension, *i.e.* 42 feet from ground.

There were three economic boilers of 6,500 lbs./steam/hour each, with separate flues as mentioned above. The oil-fired burners each used 55 gallons of oil per hour at full load and the chimney exit gas velocity then was only eight feet/second, dropping to three feet/second at low flame. The flue gas temperature for full flame was 460°F. at chimney outlet. The oil fuel was of 950 seconds grade.

Chimney exhaust fumes could be smelt at ground level 50 feet away from the boilerhouse on downwind side.

Mr. Heslop then spoke of the two steps which were taken, one to increase exit gas velocity and the other to raise chimney exit point above zone of interference by building slip-stream. After trials, conical reduction pieces 18 in. diameter were fitted to existing 30 in. diameter stacks, and then 18 in. diameter insulated double-walled steel extensions 20 feet high were fitted giving an overall height from ground of 62 feet and 22 feet above local building.

The gas velocities at full and low load were now 32 and 11 feet/second respectively, and upward discharge with satisfactory distribution, even in winds of 30 m.p.h., was sufficient.

For comparative purposes one end chimney was fitted at the top with a further reduction cone or nozzle of 9 in. diameter—this gave gas speeds of 128 and 40 feet/second at full and low loads.

By means of slight additional oil quantity, mild smoke plumes were obtained for observation and photographic measurement.

In cross winds at right angles to the line of the three chimneys, observations of the behaviour of flue gas from a normal 18 in. chimney and the 9 in. one were made at full load. An increase in upward discharge point by about 5-7 feet occurred from the 9 in. high-speed nozzle compared with that from 18 in. stack but once this plume had been bent over and deflected by the cross wind, it lost velocity and went downwind, only to join with the smoke from the 18 in. chimney, about 150 feet away. The 18 in. insulated chimney was consequently settled upon as the final method of combating down draught.

The second (*b*) installation mentioned by Mr. Heslop consisted of four 12,000 lb./hr. oil-fired economic steam boilers each pair of which was served by one 50 ft. high by 4 ft. diameter steel stack, extending 30 feet above a flat boilerhouse roof. The problem here was soot emission and down wash of gases. In winter, at full load on two boilers, the chimney top gas velocity was only 19 feet/second and in summer ($\frac{1}{3}$ boiler) was down to three feet/second. The oil consumptions were approximately 180 and 30 galls./hr. One chimney was fitted with a conical reduction to two feet diameter and a parallel portion of two feet.

The flue gas temperature, near the chimney top was 390°F. at full flame; 950 seconds fuel oil was being used.

The increased velocities were then 78 and 12 feet/second. Observations and photographic records showed the steady rise of the gas plume at full load from the 2 ft. diameter stack which continued several hundred feet away, whereas the gas from the normal 4 ft. chimney also at full load was broken by the 15-20 m.p.h. wind and drifted away horizontally. Wind deflecting collars were fitted to the three chimney tops of case (*a*) and also to the modified (2 ft.) chimney of case (*b*).

Mr. Heslop then explained that these collars are like "Eton collars" attached to the top of the chimney, conical and divergent downwards. The angle of attachment of the cone is at 30° to the vertical axis of the chimney.

Four benefits result from the use of a collar on a chimney top:

(*a*) The deflection of cross wind upwards into a direction in keeping with the upward gas plume, instead of right angle impact with the plume.

(*b*) By preventing this impact the tendency of the cold cross wind to blow the plume away from the upwind side of the chimney is prevented and the cold air downwash inside the chimney is averted.

(*c*) Downwind, on the external side of the chimney the effect of the vacuum on the gas plume is broken by the cone and the usual downwash of gas or smoke common with a normal chimney in a cross wind is prevented.

(*d*) Any soot which may be washed down by rain from the top rim of the chimney is carried clear of the stack, thereby obviating discolouration and the presence of corrosive deposits.

Alderman W. L. Dingley (Warwickshire Clean Air Council) said that in research it was difficult to get away from preconceived ideas. He wondered whether high or low chimney stacks, often heat wasting and discharging air polluting products, were necessary.

He stated that the Warwickshire Clean Air Council had urged the annual provision of huge prizes for the stimulation of more research—of which it was not possible to have too much.

T. H. Iddison (Dartford) said that it was understandable that Dr. Taylor should confine his remarks to extolling the virtues of the openable stove. The National Coal Board at present had a large surplus of hard coke it wanted to sell. Members present would recall, however, that until very recently gas boards had been saying that they had a surplus of B.S.S. coke which was sufficient for smoke control area demands in the foreseeable future. Was the National Coal Board prepared to maintain its coke ovens and, if necessary, to increase their number and output in order to meet any increased demands from the domestic market?

F. E. Ireland (Alkali Inspectorate) said he had a personal interest in the determination of chimney heights and in relation to power stations and large boiler plants registered under the Alkali Act, he had just been engaged in preparing a case history of existing chimney heights, mass emissions of sulphur dioxide therefrom and the resulting calculated maximum ground level concentrations. One thing stood out in this investigation and that was the low ground level concentration which resulted from the use of single chimneys for all the waste gases, when compared with installations using two or more chimneys, when much higher concentrations were calculated. The lesson confirmed previous authoritative opinion, that where possible, emissions should be grouped to a common chimney, so that full use could be made of thermal rise in assisting dispersion.

He also referred to the standards of grit and dust emissions which the Alkali Inspectorate had set for power stations. Reference had been made to the high cost of electricity in the home as a substitute for solid fuel and that power stations themselves caused a corresponding air pollution. The standard of 0·2 grain per cubic foot set for existing power stations meant an emission of about 14 lb. of dust for each ton of coal burned. For a 100 mw. station, small by modern standards, this resulted in a mass emission of six tons per day. Such a standard could not be tolerated for the new giant stations mentioned in Messrs. Stone and Clarke's paper, where an arrestment efficiency of 99·3 per cent was required and resulted in an emission of only 12 tons per day, *i.e.* less than 3 lb. of dust per ton of fuel burned. By comparison a ton of bituminous coal burned in a modern open grate fire gave a smoke emission amounting to about 100 lb. emitted at low level.

Mr. Ireland said that when the Inspectorate became responsible for control of emissions from power stations in 1958 they found a sorry tale of neglect of dust arrestment plant, lack of control and ignorance of performance. He was impressed by the way the C.E.G.B. had tackled their air pollution problems since that date and the next year or two should see a major improvement of dust pollution from this source.

Authors' Replies

Dr. Reed, replying on behalf of his colleagues to Dr. Turner, felt that there was no optimum efflux velocity for chimney gases and the higher the velocity then the greater the lift that will be obtained. However, the lift due to efflux velocity fell off very rapidly as the wind speed increased and then there was very little net gain: the lift due to buoyancy was normally far more important. The velocity should, in most cases, be high enough to prevent downwash; beyond this the increased cost of fan power necessary to produce the higher velocities was not justified.

In reply to Mr. Heslop's questions (*a*) and (*b*) the Memorandum on Chimney Heights issued by the Ministry of Housing and Local Government recommended minimum velocities of 20 and 25 feet/second respectively at full load. It was recognized that some downwash might occur with these velocities, but if higher figures were demanded the increased pressures in the boiler system might create other difficulties.

In case (*a*) the chimneys were so close that they should be treated as a single chimney because the plumes would mingle when they had travelled a short distance from the chimney; in fact modern practice would be to have one common chimney for all boilers. Making reasonable assumptions about the amount of SO_2 emitted and using the Memorandum the chimneys should be about 90 feet high to reduce the ground level concentrations of sulphur dioxide to an acceptable figure. Mr. Heslop's experiments were obviously carried out before the introduction of the Memorandum and he had shown how gross pollution can be avoided.

Mr. Heslop's observations of plume rise due to efflux velocity agreed with their own observations and calculations.

In case (*b*) again the two chimneys should be taken as one and in this case a height of about 105 feet for each would be necessary to comply with the Memorandum. Again Mr. Heslop had shown that downwash could be easily prevented by increasing the efflux velocity and it was encouraging to find the Ministry of Public Building and Works solving their own problems in a methodical way and, at the same time, providing information that would be of use to other people.

They had no first hand experience of wind deflecting collars on the tops of chimneys, but felt they could be beneficial in preventing downwash. They hoped to determine the effects of both cowls and collars with their experimental chimney.

Dr. A. Alan Taylor (National Coal Board), in reply to Mr. T. H. Iddison, said that a re-appraisal of the smokeless fuel supply situation was at that time being made by the Government, and in this context assurances had been given about the future availability of "Sunbrite" for the domestic market. The National Coal Board were planning to meet a substantial increased demand.

Mr. Clarke, replying on behalf of the authors of "Power Stations and Clean Air", said that they agreed generally with the points made by Mr. Draper and Dr. Turner. In reply to a question by Mr. Draper, the full load gas efflux velocity in current designs was 75 feet/second. They agreed with Dr. Turner that too high a velocity might be detrimental to the buoyancy rise of the plume besides being unnecessarily wasteful of fan power; the range 70-80 feet/second was thought to be near the optimum for a power station chimney and this seemed to be the current belief in the United States also. They were interested in the examples quoted by Mr. Heslop which demonstrated clearly the value of high velocity but, even more so, the value of having tall chimneys well clear of the turbulent wake of buildings. The latter was, of course, the purpose of the well-known "2½ times" rule used for many years now in the design of power station and other chimneys. It was a rule rather scorned by theoreticians but having the undeniable virtue of giving favourable results in practice. They were also very interested in the "deflector collars" described by Mr. Heslop, especially as wind tunnel tests on a wide variety of similar devices had in the past failed to show any worthwhile improvement to be gained.

They were pleased to hear Mr. Ireland's endorsement of the single chimney principle, a feature which was expected to become commonplace at new power stations. They could not, however, entirely agree with Mr. Ireland's summary of the state of affairs in 1958, when the Alkali Inspectorate assumed responsibility for power station emissions, although a great deal of improvement had subsequently been achieved at a number of older stations. The main direction of progress in power station design towards the achievement of cleaner air, which led to the single very tall chimney, high efficiency arrestors and close control of combustion conditions, had in fact started well before 1958.

Miss Griffith thanked Dr. Turner for his suggestion of sodium silicate as a possible material for latent heat storage. She would examine the characteristics of this substance carefully. Unless an aqueous solution is being referred to, however, the melting point is much too high for present techniques, and little appears to be known about the characteristics of the solution.

Grit and Dust Emission

(I) TECHNICAL ASPECTS AND MEANS FOR CONTROL

by

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SUMMARY

The paper describes the various types of grit arrester, their collecting efficiencies, and their costs. It discusses acid dew points and corrosion problems and the question of chimney height in relation to the dispersion of grit, dust and fumes.

Grit Arresters

DUST and grit particles from industrial plants may vary in size from one micron to over 500 microns. In order to give some practical idea of what these sizes imply it is perhaps useful to note that ordinary sea shore sand consists of particles between 100 and 300 microns in diameter, whilst face powder consists of particles measuring 20 microns down to one micron or less. One micron is one-thousandth part of a millimetre. The finest dust which normally requires collecting from industrial plants is that which emanates from pulverized fuel fired boilers.

The Beaver Report[1] suggested that 76 microns should be taken as the smallest size for "grit". A human hair is about this size in diameter. The openings in a B.S. 200 mesh sieve are 76 microns across.

The various types of grit arresting equipment available depend on one or more of the following principles: (*a*) gravitation, (*b*) centrifugal force, (*c*) filtration, (*d*) electrostatic force, (*e*) wet arresting.

Types of Equipment

1. *Settling Chambers and Simple Inertial Collectors*

If the gas velocity can be reduced sufficiently the larger particles of dust and grit will drop out of the gas stream. Settling chambers are really only useful for removing what might be termed "cinders" from the flue gases, and sometimes baffles are fitted to cause a change in gas direction to help in removing grit particles from the gas stream. Such systems have negligible gas pressure loss.

Simple inertial collectors are usually fitted in, or at the top of, the chimney. The type shown in Fig. 1, consists of a chamber fitted with metal cones or baffles. The dust laden gases passing upwards are deflected by the baffles, and expand in a larger chamber. Due to the change of direction and reduc-

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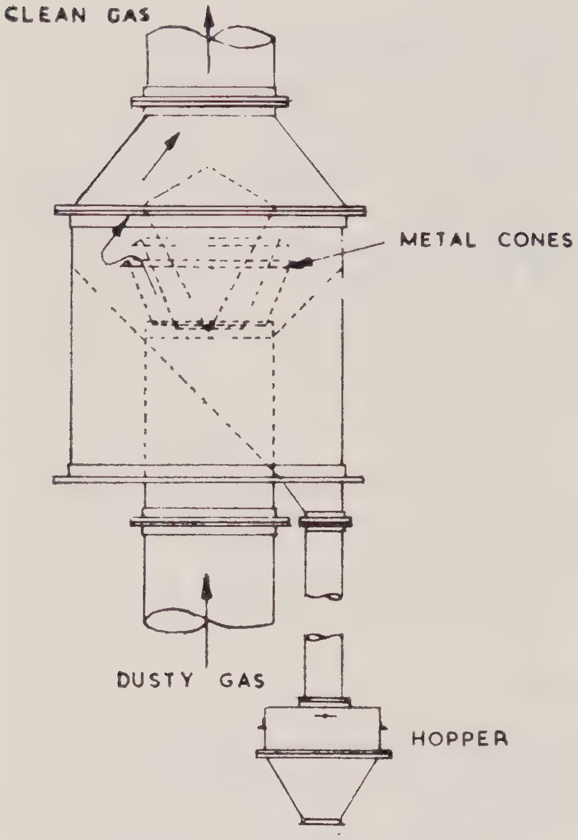


Figure 1. Inertial collector

tion in gas velocity the dust and grit particles are deposited on the sloping plate from which they slide into the collecting hopper, the cleaned gas leaving at the top central exit. The low pressure drop, 0·2-0·5 inches WG, enables it to be used on natural draught installations.

The efficiency, whilst good for the larger particles, falls off for smaller particles due to the limiting changes in velocity and direction permissible with low pressure loss.

2. *Louvred Cone Collectors*

The dust laden gas is passed at high velocity into a slotted cone (Fig. 2). The cleaned gases pass through the slots into the surrounding chamber from which they pass to the chimney. The dust remains in the cone and is carried along to the narrow end from which it is continually extracted along with 5-10 per cent of the original gases. This very dusty gas passes to a secondary cyclone collector, where the dust is extracted, and the cleaned gas returned to the collector inlet.

A high efficiency of collection is claimed with a pressure drop of the order of 1·0 inch WG.

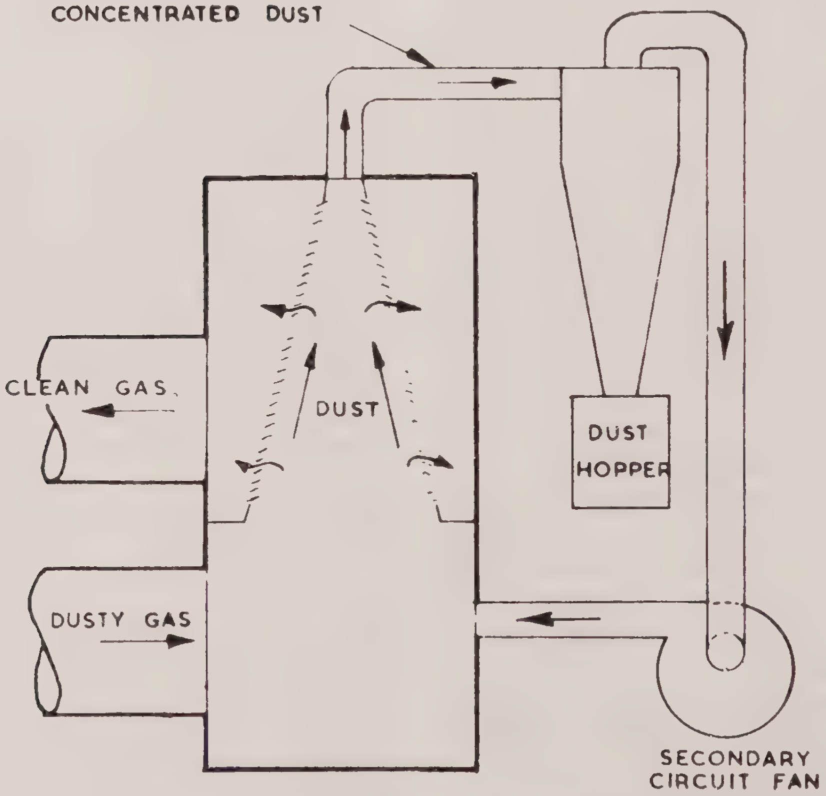


Figure 2. Louvred cone collector

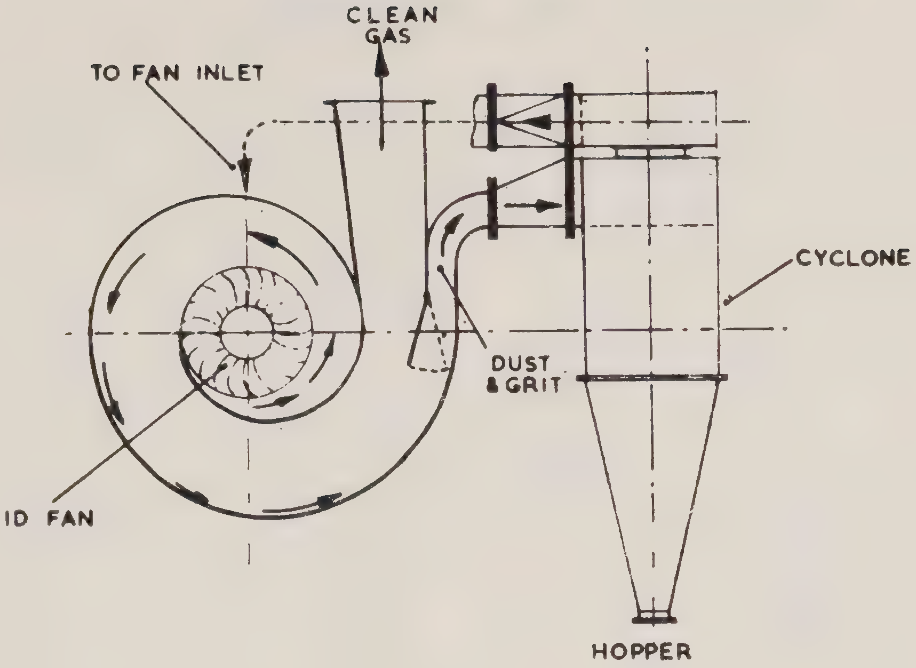


Figure 3. Scroll type collector

3. *Scroll Type Collectors*

These are units in which the dust laden gases enter an induced draught fan of special design. As shown in Fig. 3 the grit and dust are thrown, by centrifugal force, to the periphery of the fan casing and bled off, with a small proportion of the gas, to a cyclone where the dust is separated and collected, the cleaned gas being returned to the fan inlet. The pressure drop through this type of collector may range from 1·0 to 3·0 inches WG.

4. *Multi-Unit Cyclone Collectors*

This type is highly efficient and may be constructed in many forms. A diagrammatic arrangement of one form in which straight through vane entry cyclones are employed is shown in Fig. 4. The vanes impart a swirling motion to the dirty gas, throwing the dust and grit to the walls of the cyclones, and leaving the cleaned gas to pass to the main flue.

The dust, together with a small proportion of the gas, passes to a high efficiency secondary cyclone, where the dust is deposited and the cleaned gas drawn off by a fan to join the main stream of cleaned gas in the outlet flue. The pressure drop through the whole unit may range from 1·0 to 4·0 inches WG.

Design problems associated with this type of collector are (*a*) equal loading of each of the cyclones and (*b*) gas flow free from eddies to avoid clogging or build-up at any one point.

The main difference between the various units available is whether the gases enter each cyclone through a single tangential opening or through a ring of nozzles or vanes.

Bag Filters

Bag filters are mainly applied to industrial dusts since the type of material used is not normally suitable for the passage of high temperature gases, such as those from boiler plants. However, developments are proceeding in the production of suitable materials which will withstand these gas temperatures. This will mainly devolve upon the plastics industry to produce material suitable for weaving into a fabric and yet one which is resistant to high temperature and acid fume.

The bags may be up to 30 in. in diameter and up to 30 ft. in length, the method of suspension being varied with particular design. Some companies favour a lower inlet header

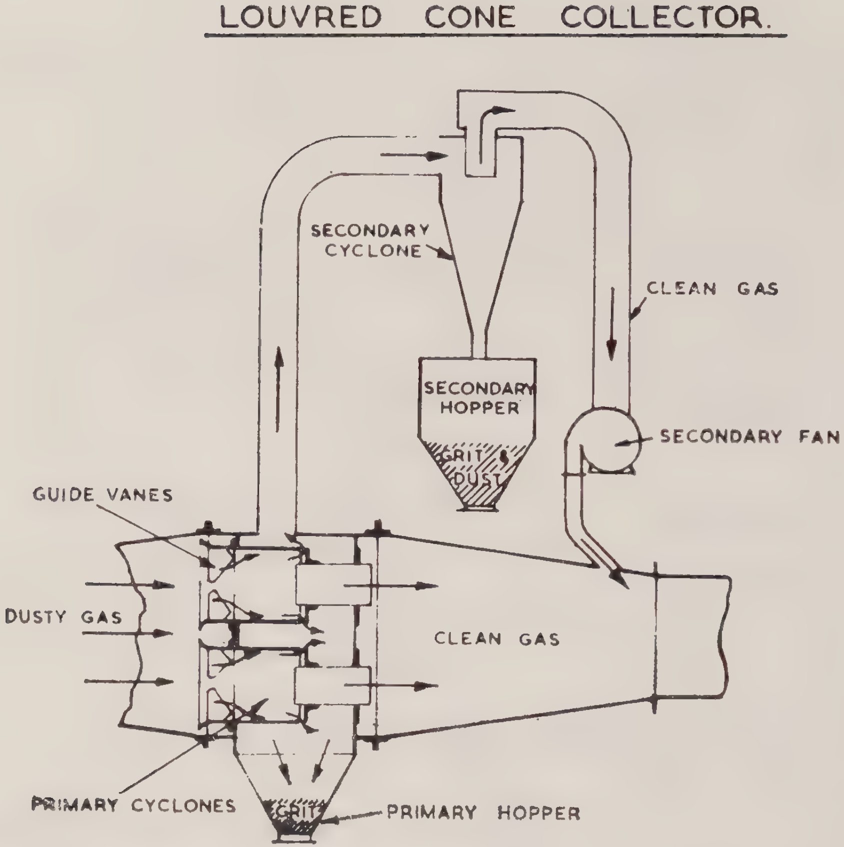


Figure 4.
Louvred cone collector

some a hopper, and some a combined header. With all of these it is necessary to have a method of shaking, if the unit is to be kept in continuous use, and designs of valves and rapping gear have been evolved so that a percentage of the total number of bags installed may be cut off from the main gas line and cleaned by the shaking mechanism at regular intervals.

In some designs, such as that marketed by the Power Gas Corporation, the switching from one compartment to another, and the operation of the plant control valves is so arranged that the pressure drop through the unit is, for all practical purposes, constant. In this design, and in others, means are provided for a reverse flow of cleaning air through the filter cloth during the cleaning operation. This cleaning air may be directed from the surrounding atmosphere or supplied by a reverse air fan and may be heated to avoid the risk of condensation in the plant if gases containing moisture are handled.

An interesting point about the bag filter is that the lower the permitted draught loss, the higher will be the efficiency of collection which is contrary to any other design. This is so because to lower the permitted loss, the area of filter must be increased and then the amount of dust collected will be higher. Very high efficiencies are claimed for these units with dusts which are below 5 micron and a figure of over 99 per cent is quoted by some manufacturers.

Electrostatic precipitators

The electrostatic precipitator is regarded as the most effective device for preventing the emission of dust from flue gases, and is practically standard equipment for large power stations. The equipment, however, is large and costly to operate so that considerations of cost limit its use for smaller boiler plants.

Due to their electrical charge, the dust and grit particles are driven to the collecting electrodes, from where they fall by gravity into a hopper. The fall of the dust is assisted by rapping gear which shakes the electrodes thus dislodging the accumulated dust.

The distance between the discharge and collecting electrodes is determined by the properties and conditions of the gas to be treated. The potential difference used depends upon the discharge gap and the type and size of electrode. Generally, potentials employed are between 30 and 75 kv.

Two main types of precipitator are in normal use, namely the wire-in-tube (Fig. 5) and the wire-and-plate (Fig. 6) types. The former is said to have better electrical characteristics but the plate type lends itself to the use of special trap-type collector electrodes that help to prevent the creep of collected particles towards the cleaned-gas exit.

The efficiency of electrostatic precipitators is governed by the gas velocity and the residence time of the particles within the equipment. Typical gas velocities are from one to six feet per sec. depending upon the type of dust and the efficiency required.

Wet scrubbers

In their simplest form the dirty gases pass through a water spray, the water droplets tending to cling to the dust particles and increase their weight so that they can be removed by gravity or change of gas direction. A typical type is that used for cupolas.

With impingement scrubbers the gases are passed through a spray curtain and then impinge on a wetted wall, or series of wetted plates, and the disintegrator type of scrubber uses a mechanically driven rotor to break up the mixed gas and spray water and give better bombardment of the duct particles.

The venturi-type units (Fig. 7) inject water into the throat of a venturi through which the gas is passing, so that during the expansion, thorough mixing occurs. The wet dust and moisture is then removed by a cyclone unit, where further spray water may be added. The pressure loss with this type is high, often 10 inches w.g. They can operate with very hot gases, up to 1,000°C.

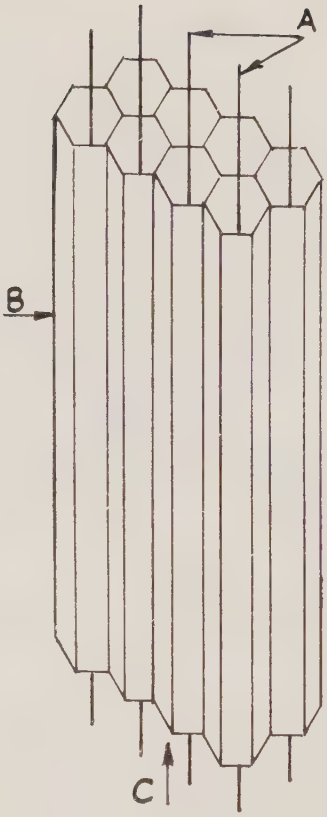


Figure 5. Wire-in-tube precipitator

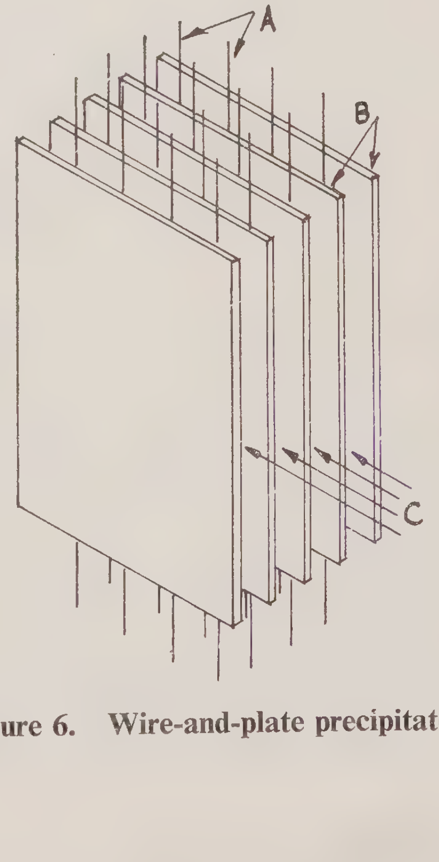


Figure 6. Wire-and-plate precipitator

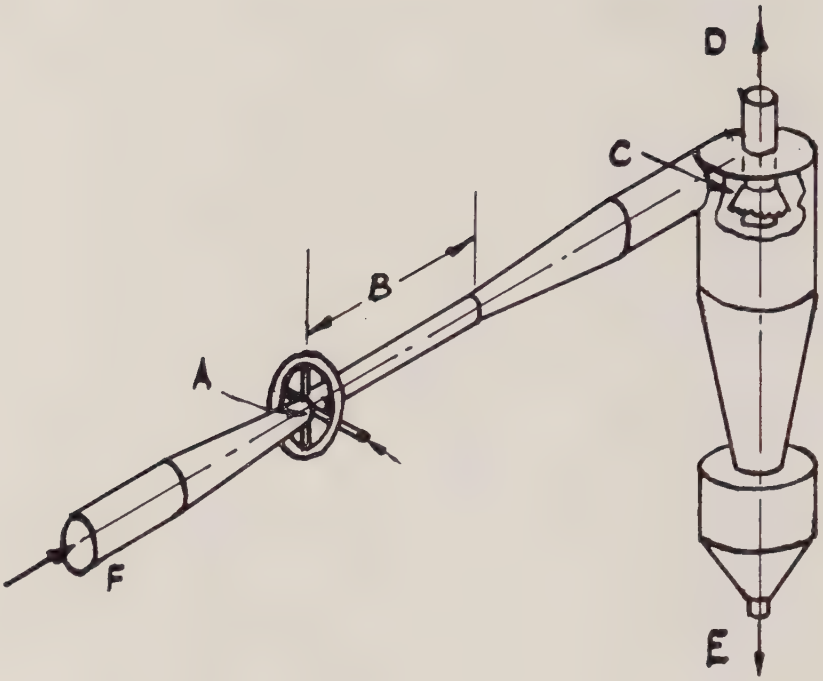


Figure 7.
Venturi-type scrubber

For the smaller boilers plants, the types almost wholly used are those relying on Centrifugal Force; the Low, Medium and High Loss types, with the High Loss type being, in general, reserved for boilers over 10,000 lbs/hour, due to high capital and running costs.

Collecting efficiencies of grit arresters

The term "efficiency" when applied to a dust collection plant can only have meaning when it is expressed in terms of particle size. If all particles were of the same size, which is far from being the case, then a quoted efficiency of 90 per cent would mean 90 per cent of all the particles were extracted. In fact, the efficiency of most arresters is 100 per cent on the largest grit particles but falls progressively as the particle sizes become smaller. Thus, each type of collector has an efficiency curve and an important point on the curve is that showing the particle size at which the efficiency falls below 100 per cent.

The grade efficiency for five types of collectors is shown on Chart 1, the curves being based on manufacturers performance figures for various draught losses through the collector. The curves presented must only be used as a guide as there are many factors, such as gas velocity, dust burden, particle size and density which will affect the performance of the installation.

Typical efficiencies on dust from mechanically fired boilers are given in Table 1.

Cost of Grit Collectors

The approximate capital costs of various types of collector, including erection charges, are shown on Chart 2. Again, the Chart must only be used as a guide, as additions or alterations to structures and the nature of foundations may increase the cost appreciably.

Depreciation, Maintenance and Power

Important aspects to be taken into account when considering the selection of a collector are the capital charges, maintenance costs, and power requirements for each type. An appreciation of these three factors is given in Chart 3, which is based on the following assumptions:

(*a*) Capital charges 10 per cent of capital cost.

(*b*) Power purchased at 1·2 pence per kWh.

CHART. I.

GRADE EFFICIENCIES FOR DUST AND GRIT COLLECTORS

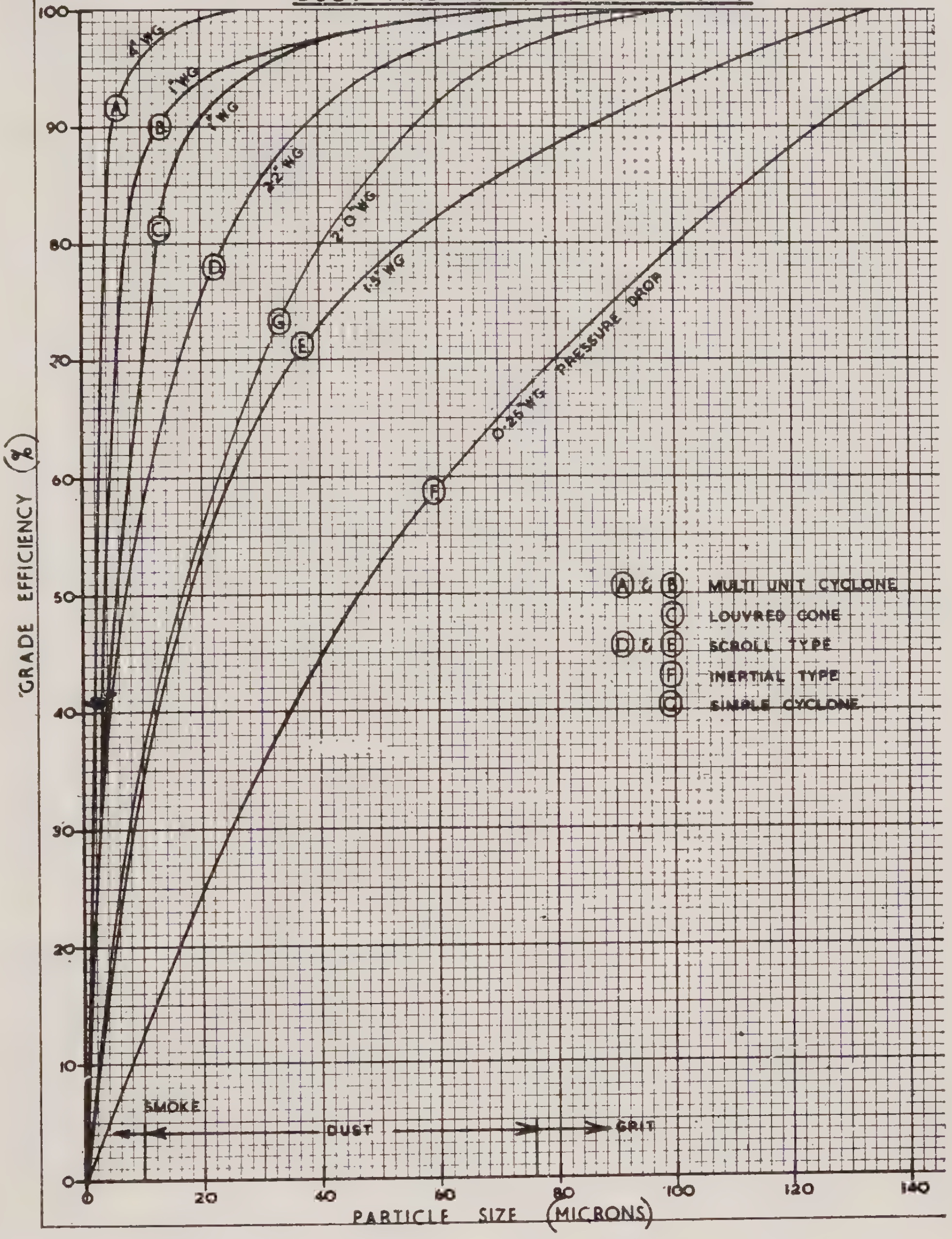
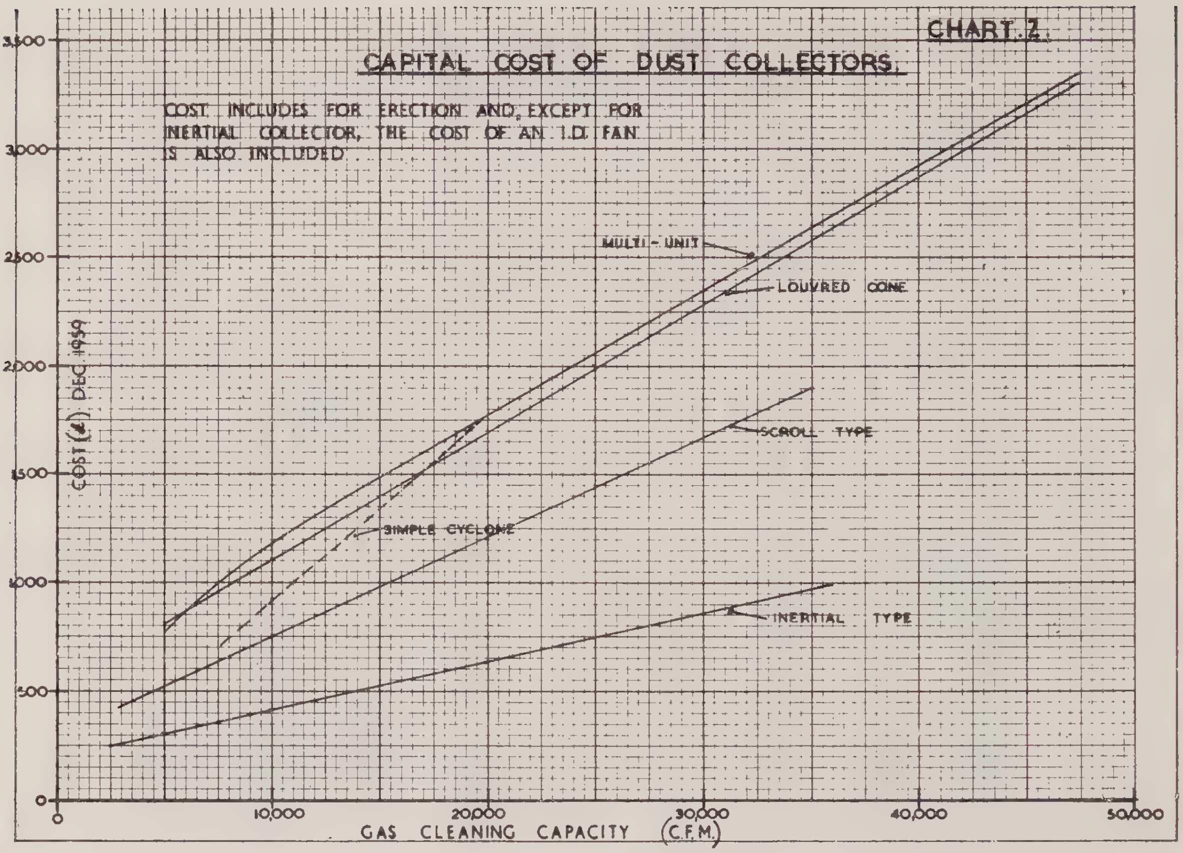


TABLE 1

Type of Collector	*Average Overall Efficiency %*	*Efficiency % with over 76 Microns*	*Efficiency % at 20 Microns*
Simple Inertial . .	58–65	85	20–25
Simple Cyclone . .	80	97	40–50
Scroll	70–85	95–99	45–60
Louvred Cone . .	90	Approx. 100	85–90
Multi-Cyclone . .	90–95	Approx. 100	90–97



(*c*) Operational period of 8,000 hours per annum.

Acid Dew Points and Corrosion Problems

One of the most obvious nuisances from an oil-fired plant is the emission of large particles of soot, generally as flat flakes and usually containing free acid. These are referred to as smuts. Recent work seems to show that smut formation is encouraged if the temperature of the internal surfaces of the plant or chimney are below the acid dew point, and it is even argued that acid condensation is necessary before smuts can form.

When an oil burner is operating, solid particles are emitted, usually quite small, often in the "smoke" range of size. It seems obvious that, other things being equal, a burner which produces more particles (as a percentage of fuel burned) is likely to give a more serious smut nuisance.

A very badly-adjusted burner with poor atomization, or flame impingement on cold surfaces quenching burning droplets may produce large carbon flakes directly, but it is assumed that ordinary servicing would eliminate this.

Factors that seem to influence the production of fine particles are oil preheat temperature and excess air percentage. Possibly further work can be done on oil temperature to check the effect of various preheats on solids emission, other factors remaining constant.

When fuel oil is burned, up to 5 per cent of the sulphur is burned to SO_3 in the flue gases and this determines the acid dew-point and so the corrosion troubles likely to be encountered. Any method of operation of a plant, or modifications to oil burners, that can reduce the percentage conversion to SO_3 will reduce corrosion (and smuts).

The mechanism of SO_3 formation has received a great deal of attention, and it seems to be divided into two parts. Most of the SO_3 is formed in the flame and the very high temperature gases immediately surrounding the flame, where the influencing factors appear to be flame temperature and

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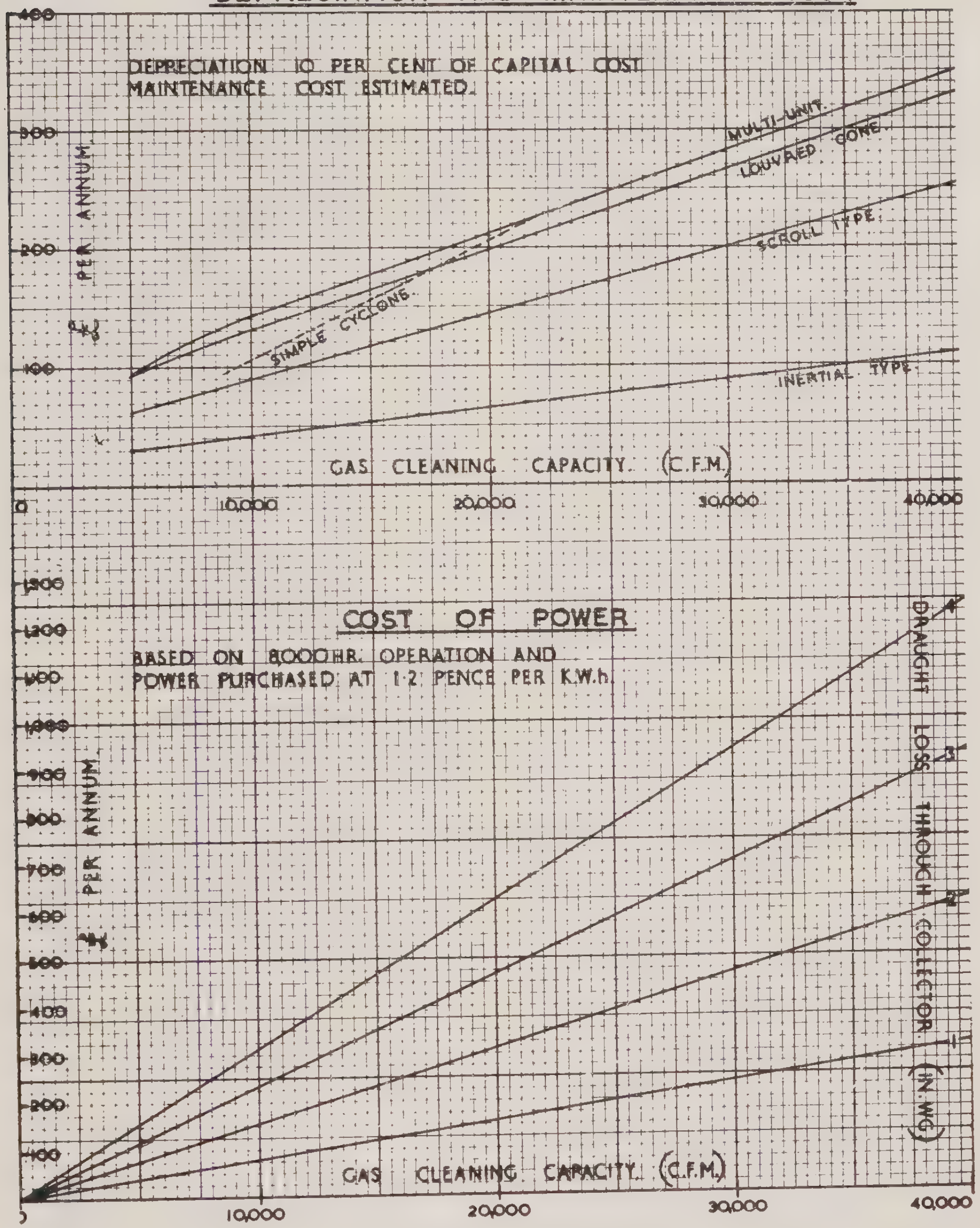
CHART 3.



DEPRECIATION AND MAINTENANCE COST.

COST OF POWER

excess air. Some SO_3 is formed by catalytic effects on hot surfaces, although the amount of SO_2 converted to SO_3 is probably fairly small, and experiments have shown that high temperatures are needed. Below about 450°C. catalytic action appears to be negligible. In large water tube boilers large areas of metal exist above 450°C., in superheater units, and the catalytic effect may be significant, but in boilers of the shell and sectional type the great majority will have all the metal surfaces cooled by water and the internal metal surfaces should be only a few degrees above the water temperature.

SO_3 will deposit (as sulphuric acid, H_2SO_4) on walls of boilers flues and chimneys at quite high temperatures. The actual temperature at which deposition begins is referred to as the "acid dew point", and varies with the concentration of SO_3 in the flue gases, but is usually within the range 110–160°C.

Research on large water-tube boilers has established that significant reductions in SO_3 formation occur as the amount of excess air used in combustion is reduced to very low figures. The usual curves in literature show a fairly constant ratio of SO_3 to SO_2 in the gases (*i.e.* constant conversion percentage) as the excess air quantity is reduced, until very low excess air figures (say 25 per cent.) are reached, when the conversion to SO_3 reduces rapidly.

The excess air factor works somewhat in opposition to the effect on SO_3 already discussed, as a reduction of excess air below about 50 per cent. seems to cause a marked rise in weight of solids emitted. (It is impossible to eliminate all solid emission, as heavy fuel oil contains small traces of "ash", usually around 0·05 per cent.). Load also seems likely to affect the problem, and it could well be that different burning rates may give different percentage solid emissions at the same excess air figure.

It seems that the plant being fired is the controlling force; if large cool surface areas exist below acid dew point, then acid smuts will be formed providing the burner provides some SO_3 and carbon particles. Reduction of SO_3 would lower the acid dew point and reduce the total area on which condensation and subsequent smut formation occurred, and the acidity of the smuts might be reduced since at lower acid dew points the condensation reaches equilibrium with gases at lower H_2SO_4 concentration.

The major practical remedies are:

(*a*) Insulation of flues and chimneys to try to reduce any areas of metal below acid dew points. See Fig. 8.

(*b*) Elimination of air infiltration which might cool gases and surfaces to acid dew point.

(*c*) Maintenance of highest possible CO_2 figures.

(*d*) Good burners, kept in good condition, to try to minimize the amount of solids leaving the combustion chambers.

(*e*) Additives, which neutralize SO_3, have been shown to give some improvement in some cases where other methods have failed. Ammonia gas and powdered dolomite have been used, but results vary. Both give fouling troubles, sometimes slight and sometimes very severe. With ammonia, fouling is at the cool end, on economizers and air heaters, and this would probably occur on small boilers too. With dolomite the serious troubles seemed mainly to be slagging on refractory brickwork near burners, and hard deposits on superheaters, and it is felt these troubles might not occur on small shell boilers. Deposits on economizers and air heaters did occur with dolomite but are reported to be easily removed by water washing, etc.

Chimneys

Assuming the chimney is situated on a level area with negligible effect due to surrounding buildings, then the concentrations of gases reaching ground level are covered by the Sutton Equation[2], which in one form states:

Maximum likely ground level concentration of SO_2 in parts per hundred million

$$= 75{,}000 \frac{(SO_2 \text{ produced in lbs/hour})}{\text{Wind speed in ft/sec x } H^2}$$

where H="effective height" of chimney.

This effective height consists of two components, the actual height of the chimney plus the height to which the plume of gas rises above the top of the chimney before its upward movement ceases due to cooling and diffusion. This latter figure is largely governed by mass and temperature; other things being equal a hotter plume rises further than a cool one, and alternatively a thick column with greater mass of gases rises further than a thin column of less mass.

The equation also applies for other solid and gaseous constituents with appropriate units and constants.

The thermal plume effect has been investigated in considerable detail and

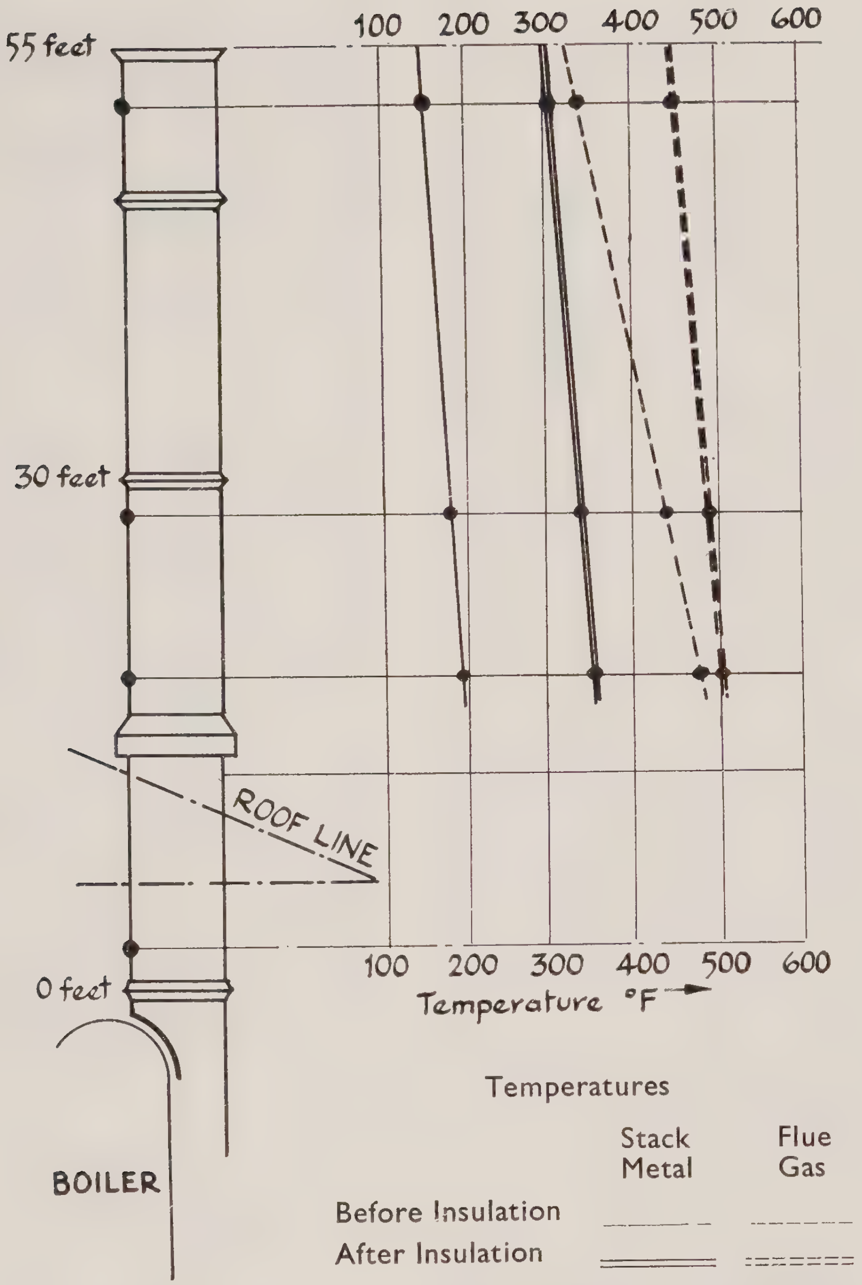


Figure 8. Temperature distribution in metal chimney

graphs show typical relations between temperature discharge rate and the height of the plume. Methods to improve dispersal can be summarized as follows:

1. Temperature of Gases

(*a*) It may be possible by insulation of the flues, fan casings and the stack itself, to increase the temperature of the gases quite considerably, this in turn will give a higher thermal plume and lower ground level concentrations.

(*b*) Any air infiltration after the combustion chamber itself will have a bad effect because it cools the gases and the flues. Any obvious gaps in flues or around the dampers should be sealed. Gas stabilizers and on/off oil burners tend to allow quantities of cold air to pass through the system when no fuel is being supplied.

An automatic damper with draught controllers is better than a draught stabilizer, and a modulating burner better than an on/off type. Spare boilers need positive isolation by fitting gas-tight dampers. All these alterations increase the gas temperature.

2. Velocity of Gases

If the gases leaving the top of the chimney are at very low velocities, then wind effects around the chimney may cause down-draughts dragging volumes of gas down the lee side of the chimney. Exit velocities should be of the order of 20 ft/sec. to prevent this. Higher velocities than these do not further improve the position, as they cause faster mixing of the gases with air possibly destroying any thermal plume effect. In extreme cases venturi fittings have been used whereby proper design and very high gas velocities, improvement has occurred.

3. Mass of Gases

In some Industries (Chemicals) gases such as SO_2 or chlorine may be given off in small quantity from the process. If these gases were led to another chimney already carrying a large mass of gas, then the thermal plume effect might give a greater rise to the noxious gases than would occur if they passed into their own small stack. Similarly with the boilerhouse it is better to combine the gases from all the boilers into a single stack rather than have individual chimneys.

4. Height

If after considering all the previous items the ground level concentrations are higher than desirable, increasing the height of the stack may be the only solution. As will be seen from the Sutton Equation even a fairly small increase may have pronounced effect. Unfortunately such increases are usually very expensive, as the extra weight may involve new foundations or supports for the chimney.

5. Surroundings

The Sutton Equation assumes suitable conditions but surrounding buildings or sloping land may cause turbulence near the chimney and bring the gas down to ground level very quickly and in much greater concentrations than the Equation suggests. Particular examples are chimneys slightly lower than the building upstream of the chimney or sloping land down-wind of the chimney, in such cases the only remedy is to increase the height to get the top of the chimney above the turbulence, or, if possible, to move the chimney away from the offending building.

Clean Air Act and Requirements

The height of a chimney for a specific boiler plant has to be "approved". No rigid table yet exists from any official source, but a good guide is that in the paper presented to The Institute of Fuel by G. Nonhebel[3] (Journal Inst. Fuel, Vol. XXXIII, No. 237, Oct. 1960), however it must be remembered that such calculations require information about temperatures, wind velocities, etc., that is seldom available to anyone having to design the chimney for a new boiler plant.

The F.B.I. Working Party[4] which, under Mr. Nonhebel's leadership, considered these matters, decided to give general rule for the height of chimneys for small boiler plant. Their recommendations are:

Maximum Continuous Rating of Boiler Plant lb. steam/hour	*Minimum Chimney Height*
Up to 5,000	60 feet
5,100 to 12,000	80 feet
12,100 to 21,000	100 feet
21,100 to 33,000	120 feet

The Ministry of Housing and Local Government issued, in May 1963, a "Memorandum on Chimney Heights"[5] as a guide to local authorities exercising their powers under Section 10 of the Act. The Memorandum provides a relatively simple method of obtaining the approximate height desirable in normal circumstances. The charts start from the estimated emission of SO_2 from the chimney, which can be obtained from maximum burning rate of fuel analysis. If maximum burning rate of solid fuel is W thousand lb/hr. and the sulphur content is S%, the weight of SO_2 emission = 18 WS lb/hr. (allowing for 10% of S retained in ash) and for liquid fuels = 20 WS lb/hr. The charts are intended to apply to all industrial boiler plants exceeding 650 lb/hr. (or 650,000 B.Th.U/hr.) total rating, or to furnaces burning more than 100 lb/hr. solid fuel or 50 lb/hr. of oil.

The charts also assume that except for small boilers, the efflux velocity should be at least 20 ft/second at full load; boilers with induced draught fans should have efflux velocities of at least 25 ft/second at full load and ratings up to 30,000 lb/hr., increasing to 50 ft/second for boilers of 450,000 lb/hour.

Corrections are given for:

(*a*) Character of the surrounding district, in five categories ranging from undeveloped areas with low back-ground pollution and no development within half a mile, to large cities with severe back-ground pollution. The corrections demand progressively higher chimneys for the same plant as the background position alters.

(*b*) Buildings to which the chimney is attached, or buildings in the immediate vicinity, if the chimney height so far calculated is less than 2½ times the height of such buildings. This correction is based on the length of adjacent buildings as well as their height, and in any event the final chimney height must never be less than 10 ft. above the ridge of the building.

New boiler plant burning 1 ton or more of solid fuel per hour MUST have acceptable grit arresters fitted; existing plant is required to use the "best practicable means" to minimize grit emission. Any plant using pulverized fuel, even if below a rate of 1 ton/hour, must fit grit arresters. The Clean Air Act does not lay down any figures for permissible dust and grit contents in the flue gases leaving the chimneys of boiler plant, and no guidance has yet been given by the Government. Various organizations have made suggestions covering a range of about 0·2 to 0·3 grains per

As comparative examples to the F.B.I. Handbook, for typical boilers, figures are as follows:

Size of Plant	*Maximum Fuel Burning Rate lb/hr.*	*Calculated SO_2—lb/hr.*	*Chimney Height in feet*				
			F.B.I. Graph	*"Memorandum in Chimney Heights"*			
				Uncorrected for Buildings		*Corrected for long 40 feet High Buildings*	
				District "A"	*District "E"*	*District "A"*	*District "E"*
5,000 lb/hour solid fuel fired boiler; 1% S ..	530	9·5	60	49	56	65	71
5,000 lb/hour oil fired boiler; 2% S ..	350	14·0	60	52	61	67	74
12,000 lb/hour solid fuel fired boiler; 1·5% S	1,380	37·3	80	62	75	75	82
12,000 lb/hour oil fired boiler; 3% S ..	830	49·8	80	73	88	81	91

The Memorandum recommends a 10% addition to uncorrected chimney heights for oil fuels containing more than 2% S, and this has been included for the last case in the above table.

cu. ft. of gases (at N.T.P.) but it must be realized that the size distribution is important. If all the solids were in the form of relatively large particles, say about the 76 micron size defined as "grit" in the Beaver Report, then the emission mentioned above would be a considerable nuisance.

These relatively large particles have a quite high falling speed, so that they would all reach ground level fairly near to the plant and high local concentrations would occur.

Fortunately, even the relatively cheap and simple type of grit arresters have a high collecting efficiency for particles above 76 microns.

Smoke is of course defined as a nuisance by comparison with Ringelmann No. 2 shade, and the Clean Air Act allows some small element of time for dark smoke emissions for boilers outside Smoke Control Areas (smokeless zones) to allow for soot-blowing, fire-cleaning, etc.

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[3] Recommendations on Height for New Industrial Chimneys, by G. Nonhebel, Journal Institute of Fuel, October 1960, pages 479–495.

[4] Recommendations on Height and Design of New Chimneys for Industrial Boiler Plants. Federation of British Industries, June 1961. (4s.).

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(2) ADMINISTRATIVE PROBLEMS OF CONTROL

by

*F. G. Sugden**

D.P.A., M.R.S.H., F.A.P.H.I., A.M.I.P.H.E.

SUMMARY

The paper considers the administrative problems which can arise in the control of grit and dust emission. The author begins by examining the legal background, and discusses some of the problems which have arisen in practice in the interpretation of the law, and he makes suggestions in certain cases as to how the law might be amended.

In order to make the paper of more general application the author has sought information from the Chief Public Health Inspectors of a number of Local Authorities where problems of grit and dust emissions exist, and the paper discusses in more detail a number of practical administrative problems which seem to have arisen. Amongst these are the relationships between Local Authorities and their officers and the Alkali Inspectorate; the problem of what is reasonably practicable for cold blast cupolas; problems concerned with iron and steel works, electricity generating stations and cement works. Consideration is also given to the methods to be used in determining the sources of emission, and some information is given about apparent trends in pollution.

A PAPER which has already been presented to you has dealt with the technical aspects of the control of grit and dust emissions, and this has shown the extent to which, in the light of present technical knowledge and development, it is possible to prevent or minimize the amount of grit and dust emitted to the atmosphere. There are two points which cannot fail to have impressed you. Firstly there is the great complexity which is involved in having to deal with dust and grits of such wide variations in size and nature, provided in such greatly differing concentrations, and at such wide ranges of temperature. It is quite obvious that in these circumstances one cannot hope for any simple answer which is going to solve all our problems. Secondly there is the evidence of the vast amount of technical research which has been carried out during the past few years in an effort to evolve ever improving arresting appliances. One cannot help feeling that the introduction of the Clean Air Act, 1956, has played a great part in encouraging this work.

The technical experts and the research workers discover and develop the appliances capable of preventing the emission of these materials to the atmosphere, but it falls to the lot of the administrator to ensure that what has been made possible is in fact used, although, of course, the administrator must work within the framework of the legal powers which have been given to him by Parliament. In this case, these are to be found in the Clean Air Act, 1956, and the Public Health Act, 1936, and we must first examine the powers which are given by these enactments.

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The Legal Background

Clean Air Act, 1956

The passing of the Clean Air Act, 1956, is a most important milestone in the control of grit and dust emissions. For the first time, the legislature has recognized that the control of this type of emission is an entirely different matter from the control of smoke emissions, and the Act contains sections specially drafted to deal with these emissions.

Section 5 requires that in the case of all furnaces (other than certain small domestic heating furnaces) there shall be used any practicable means there may be for minimizing the emission of grit and dust from its chimney.

Section 6 provides that all new furnaces for burning pulverized fuel or burning more than one ton per hour of solid fuel or solid waste, and all ovens subjecting solid fuel to any process involving the application of heat, shall be provided with plant for arresting grit and dust, which has either been approved by the Local Authority or installed in accordance with plans and specifications approved by the Local Authority. The section also requires that such arresting plant shall be properly maintained and used.

Section 7 makes provision for the Minister to make regulations requiring the occupiers of buildings containing furnaces burning pulverized fuel or furnaces burning solid fuel or solid waste at a rate of more than one ton per hour; or ovens subjecting solid fuel to any process involving heat, to install, on the requirement of the Local Authority, appliances for making and recording measurements from time to time, of the grit and dust emitted from the furnace or oven. The results obtained from the instruments to be made available to the Local Authority. The Minister has not as yet made any such regulations.

Section 8 empowers the Local Authority to require such information from occupiers of premises containing furnaces and ovens as may be required by them to enable them to carry out their functions under Sections 6 and 7.

Section 9 applies the provisions of Sections 5, 6, 7 and 8 to furnaces or industrial plant not within buildings but attached to a building, or for the time being fixed to or installed on any land.

Section 10 allows the Local Authority to reject the plans of any buildings (other than residences, shops and offices) unless they are satisfied that any chimney proposed to be constructed is of sufficient height to prevent smoke, grit, dust and gases from becoming prejudicial to health or a nuisance.

Section 17 provides that the smoke grit and dust provisions of the Clean Air Act shall not apply to premises controlled under the Alkali, etc., Works Regulation Act, 1906. It also allows for the Minister to add to the list of works coming within the Alkali Act, or he may on the application of a Local Authority, allow that Authority to apply the provisions of the Clean Air Act to such premises or types of premises within their area as he may direct.

Where premises are controlled under the Alkali Act, Sections 1 (dark smoke), 5 (prevention of grit emission) and 16 (smoke other than dark smoke of such nature as to be a nuisance) still apply but no proceedings may be taken without the prior consent of the Minister.

Public Health Act, 1936

Grit or dust nuisances arising from processes not connected with the burning of fuel, cannot be dealt with under the Clean Air Act, and in these cases Section 92 of the Public Health Act, 1936 applies. This declares "Any dust or effluvia caused by any trade, business, manufacture or process which is prejudicial to health or a nuisance to the inhabitants of the neighbourhood" to be a statutory nuisance for the purposes of the Act. Such cases may therefore be dealt with by the service of abatement notices by the Local Authority and the issue of nuisance orders by the Courts. The consent of the Minister is required for action by a Local Authority in respect of any process registered under the Alkali Acts. It is a defence to prove that the best practicable means have been taken for preventing or controlling the effect of the dust or effluvia.

For the purpose of determining whether the best practicable means have been taken for preventing or counteracting the effect of a nuisance, a court must have regard to cost and to local conditions and circumstances.

Practical Administration of the Law

New and Existing Furnaces

On first examination it would seem as though the powers made available ought to be reasonably adequate for controlling all types of grit and dust emissions. We have a tidy administrative pattern with separate sections for dealing with emissions from existing premises and for preventing emissions from new premises, and provision in a previous Act for dealing with dust and fume emissions from processes not connected with the burning of fuel. It is not until one comes down to actually applying the law to definite cases that difficulties and problems become apparent. In the seven years that have elapsed since the passing of the Act, Local Authorities and their officers have found from experience what these problems are.

In an endeavour to make this paper as comprehensive and complete as possible, I have endeavoured to obtain information from other Local Authorities in order that I could present a representative picture of the problems being met with. In all, the Chief Public Health Inspectors of no less than 75 Authorities supplied information and observations, and it is impossible for me adequately to express to them my appreciation of their assistance. Without the information and assistance which they have given, this paper could of necessity have only dealt with the types of problem which have come within my own personal experience. The Local Authorities contacted, were all in areas where it was anticipated that grit and dust emissions might represent an atmospheric pollution problem. In actual fact, 55 Authorities considered that they had such a problem, and 20 felt that it was not a problem within their area.

Section 5 of the Clean Air Act requires the use of "any practicable means there may be for minimizing the emission of grit and dust from any chimney". This phrase has led to differences of interpretation in some cases. There has even been disagreement as to what is meant by "minimizing", and there are some who have apparently regarded the word as being synonymous with reducing, and have agreed that the provision of appliances which in any way reduced the amount of grit emitted, complied with the requirements of the Act, even though there might be other types of arresters with greater efficiencies available. The dictionary defines "minimize" as "reduce to the smallest possible amount or degree" and I feel sure that this is what was intended when the word was used. The words "any practicable means there may be" are rather more difficult, and they have been defined in the Act as follows: " 'practicable' means reasonably practicable having regard amongst other things to local conditions and circumstances, to the financial implications and to the current state of knowledge, and 'practicable means' includes the provision and maintenance of plant and the proper use thereof".

Thus we see that in effect the two things which in practice have to be considered before deciding what can be asked for, are, (*a*) local conditions and circumstances, and (*b*) the financial implications. The local conditions and circumstances clause may in some cases be of more value to the Local Authority than to the industrialist, as it may enable them in the case of grit or dust emitting plants situated in closely built up areas, to ask for higher standards of arresting efficiency than might be accepted were the premises well isolated from other premises. In reverse, there have been cases where it has been argued that if grit of large size is emitted from a works covering a large area, most of it falls within the area of the works, and that therefore if the firm concerned were not worried about it, why should anyone else be. The answer is, of course, that prevention of pollution is essentially a health measure, and that we are as much concerned with the health and well-being of those employed within the works as we are with the health of those living outside.

The consideration of financial implications can be the most difficult of problems. Obviously, one could not ask for the installation of electrostatic precipitators or other extremely expensive appliances where the cost of the arresting equipment would be much greater than the full cost of the plant it was to serve. Fortunately, there are few if any cases where this would be even technically desirable. But the provision of grit and dust arresting equipment must inevitably involve some burden upon the industry concerned. The financial considerations involved in minimizing grit and dust emissions are much more difficult than those involved in the eradication of dark smoke. In the latter case it is usually possible to show that the replacement or adaptation of equipment to prevent smoke nuisance will result in improved fuel efficiency, which may in due course re-imburse the original cost involved. When dealing with grit and dust emissions no such attraction can be offered. On the contrary, the industrialist will be faced with the original installation cost, the cost of maintenance and operation, and sometimes with difficulty in disposing of an end product. As a result, we are dependent upon the provisions of the law and the sense of public responsibility of the industrialist.

In deciding the reasonableness or otherwise of the requests to be made to industry, there are some important questions of principle which must be decided. As we have seen already, there are different types of arresting appliances with varying rates of efficiency. Generally speaking, the greater the efficiency, the higher the cost. At any one time in any industry there are units operating at varying degrees of financial efficiency. There will be some firms at the top showing considerable profit margins, and others at the bottom only just managing to exist. If they are all doing the same kind of work and producing the same types and quantities of grit and dust, should they all be asked to provide the same standard of arresting equipment even though it may mean that some firms may have to go out of existence, or does consideration of financial implications mean that firms shall be asked to provide equipment of varying standards, based not upon the nuisance they cause, but rather upon their ability to pay? Justice would appear to demand that all firms should be treated alike, but it is easy to understand the reluctance of a Local Authority to take measures which might result in the closure of firms providing employment within their areas.

It might be of value to Local Authorities if some independent general guidance could be given to Local Authorities on what might be regarded as reasonably practicable means for dealing with emissions from the various grit and dust producing industries. This might enable many works to be dealt with without difficulty, and yet leave latitude for dealing with special cases where either the industrialist felt there was a sound reason why he should do less, or where the Local Authority felt they should ask for more. Some attempt has been made to do this in the Iron Foundry trade, and this will be commented upon later.

Section 6 which deals with new furnaces represents a very praiseworthy attempt to ensure that new plant capable of emitting grit or dust shall be fitted with arresting equipment of a type approved by the Local Authority before being brought into use. It is interesting to note that the application of this section does not appear to involve the difficulties of "practicable means". The Local Authority can ask for what they think is required, but there is a right for a person aggrieved by a refusal of approval to appeal to the Minister. It is to be hoped that Local Authorities will be forward looking in fixing their standards, and that they will have the support of the Minister. Great strides are being made in the technique of grit and dust arresting, residents in industrial areas are becoming more interested in demanding that emissions be controlled, and are likely to become even more so as domestic smoke control programmes progress. Acceptance of bare minimum standards today could result in the existence in a few years of plant with arresting equipment of an unacceptable standard, thus causing dissatisfaction and frustration to both Local Authorities and Industry.

It must be remembered of course that the section only applies to plant burning pulverized fuel, or solid fuel at the rate of more than one ton per hour, or to ovens and retorts subjecting solid fuel to processes including the application of heat. When more experience has been gained of the operation of this section, there might well be a good case for extending it to smaller plants in the types of industry likely to cause grit and dust emission.

Measurement of Grit and Dust Emitted from Furnaces

The power taken by the Minister to make regulations allowing Local Authorities to require the recording and measurement of grit and dust emissions has been welcomed by all interested in atmospheric pollution control, and it is a matter of regret that no such regulations have been issued. It is understood that at the time of the passing of the Clean Air Act, the only available methods of measuring grit and dust were lengthy and complicated in practice, but since then, in 1961 the British Standards Institution published British Standard 3045—"Simplified Methods of Measurement of Grit and Dust Emission from chimneys". One would have thought that this might have produced a basis for regulations under Section 7. It is appreciated that the equipment required is not cheap (approximately £400) but in view of the fact that the Section deals mainly with the larger type of fuel burning plant, one would have thought that the capital cost was small compared with the amount being spent on fuel. The measuring equipment will mainly be required in plant where either arresting equipment exists or is going to be required. In the former case, the industrialist is as interested in ensuring that he has got value for money as the Local Authority is interested in ensuring that reasonably practicable methods have been adopted. In cases where arresting plant is likely to be required, it is of great importance to the Industrialist to know what is the extent of the problem with which he has to deal.

It is to be hoped that regulations will be issued by the Minister with the minimum of delay, even if in the initial stages they only apply to limited classes of furnaces. In due course they could be extended to most if not all of the grit and dust producing processes.

Information about Furnaces and Fuel Consumed

It is important to remember that the power given by Section 8 to require information about furnaces or fuel consumed, applies only to plant controlled by Sections 6 and 7, that is to say furnaces burning pulverized fuel, solid fuel or solid waste at the rate of a ton an hour or more, or ovens subjecting solid fuel to heat. One could not for example ask for information about a cupola furnace if it had a fuel consumption of less than one ton per hour. The whole position seems somewhat farcical in so far as before one can decide whether the right exists to ask for information about the type and quantity of fuel consumed, one must first know the answer. There seems to be no sound reason why the power should not apply to all industrial furnaces, and permit the seeking of information to enable the Local Authority to assess the risk not only of grit and dust emission, but also of dark smoke emission.

Grit and Dust from Outdoor Furnaces

Section 9, which is another effort to make the Clean Air Act all embracing, appears to have caused few problems, although one case of difficulty has been brought to my notice. The section applies to the furnace of any boiler or industrial plant attached to a building, or for the time being fixed to or installed on any land. Doubt has been expressed as to whether the phrase "installed on any land" is sufficiently wide to include mobile plant operating on any particular site.

Height of Chimneys

Section 10 clearly allows Local Authorities to take into consideration the possibility of grit and dust emissions in fixing the heights of new chimneys, although it is interesting to note that the advisory memorandum recently issued to Local Authorities is based upon the dispersion of sulphur emissions. The memorandum suggests that the correct way of dealing with grit and dust is to arrest it before emission, and that the recommended chimney heights will be suitable for most processes provided that proper grit arresting equipment is fitted. Nevertheless it has to be remembered that there are some processes where the amount of grit, dust or fume can be so great that even after the most efficient arresters have been used, the amount remaining may still be sufficient to cause nuisance unless discharged at a sufficient height for efficient dispersal. Most of these plants will be ones registered under the Alkali Works Acts, and therefore presumably not subject to Section 10, although in fairness it must be said that the Alkali Inspectorate are enforcing very strict standards about the heights of chimneys. There are also plants coming within the control of the Local Authority where chimney heights may be an important factor in preventing nuisance from grit and fume emission. The cold blast cupola is one such case which comes to mind.

Premises Controlled under the Alkali Acts

Anyone not used to British methods of compromise and co-operation would be surprised at the administrative pattern by which emissions from some types of plant are controlled by the Alkali Works Inspector of the Central Government, and emissions from other types of plant are controlled by the Public Health Inspector of the Local Authority. When such a person found that the division of responsibility went so far as to provide circumstances under which both officers could have plant for which they were responsible within the same premises, he might well expect to find the result to be near chaos. In actual practice, things appear to work quite smoothly as a result of a spirit of common sense co-operation which exists between Alkali Inspectors and Public Health Inspectors. No doubt on occasion the Public Health Inspector will complain to an Industrialist about nuisance from some plant which really comes within the province of the Alkali Inspector, and I am quite sure that the Alkali Inspector will sometimes give advice on plant subject to the control of the Local Authority. It would be most unfortunate if it were otherwise. If each officer tried to keep absolutely exclusively to his own field, and when asked about other plant simply shrugged his shoulders and retired behind a barrier of red tape, the effect upon the Industrialist and the Public would be disastrous. The most important thing is that there must be full co-operation and absolute trust between the two officers. This can be best achieved by regular and frequent contact, and a recognition of the fact that what really matters is the end result—the reduction of pollution.

In a recent questionnaire, 53 Chief Public Health Inspectors were asked whether they considered the co-operation between themselves and the Alkali Inspector to be satisfactory or unsatisfactory. 48 Officers said without any reservations that they considered the co-operation to be satisfactory. Five officers considered the co-operation to be fairly satisfactory, but felt that it could be improved. Their chief points seemed to be a desire for more information as to what was being done, complaints of the inaccessibility of the Alkali Inspector as a result of the large area covered by each such officer, and the failure of the Central Government to provide him with an office. It seems that the great majority of Chief Public Health Inspectors have achieved a useful co-operation and liaison with the Alkali Inspector, and as most of the officers replying to the questionnaire represented Authorities where there was a great deal of work done by the Alkali Inspector, there is no reason for believing that the replies are other than typical of the views of Public Health Inspectors throughout the country.

I cannot help thinking, however, that if the same question had been addressed to elected representatives on Local Authorities, especially those in Iron and Steel producing areas, the replies would not have been so encouraging. Why should this be so? The chief reason is, I think a failure in the system of communication. As a general rule the Councillor stands nearest to the people. He frequently lives amongst the people whom he represents, and it is to him that they turn when they wish to complain about conditions adversely affecting their environment. If he wishes to raise matters coming within the purview of the Local Authority it is relatively simple, he can ask his questions or initiate a discussion in the appropriate Committee or at a Council Meeting, and he can expect the officers concerned to explain what is being done. But if the plant concerned is one registered under the Alkali Acts he may merely be told that it is a question for the Alkali Inspector. He may go further, and persuade his Authority to make informal approaches to the Alkali Inspector, and in due course he will probably be informed that everything possible is being done, but in many cases very little detailed information will be provided. If the relationship between the Public Health Inspector and the Alkali Inspector is as good as in most cases, the Public Health Inspector may be given more detailed information about progress being made, but such information will be given on a confidential basis and is not intended for onward transmission. I am convinced that there are many cases of Local Authority criticism of the Alkali Inspectorate which arise from a simple lack of knowledge of what is taking place. Can anything be done to improve our public relations?

To be absolutely fair, one must admit that the whole matter bristles with difficulties. Quite understandably the Industrialist discussing his problems with the Alkali Inspector does not want or expect his affairs to be made known to some other body. Here one might make a passing comment on the surprising fact that there are many instances where firms who have spent large sums of money in reducing emissions to the atmosphere are most reluctant to let anyone know about it. One would have thought that they would have been keen to obtain publicity for their work, if only to avoid the continuing finger of criticism being pointed at them. But obviously, if firms are shy at letting it be known that they have done this kind of work, they are likely to be even more shy about third parties being kept aware of their negotiations with the Alkali Inspector.

Might it not be possible for some arrangement to be made whereby a Local Authority in whose area there were plants registered under the Alkali Act which gave rise to local concern, could have an annual visit of the Alkali Inspector to their Health Committee, thus providing an opportunity for that officer to give as much information as possible without breaking any confidences about progress being made, and an opportunity for elected representatives to ask questions? I realize that the area covered by each Inspector is a large one, and comprises the areas of many Local Authorities, but by no means every Local Authority area includes a registered process, and not every registered process is the subject of public concern. What has been so frequently said in the past about justice—that it must not only be done, but must also be seen to be done, applies today to a great number of public services, and I am convinced that the control of atmospheric pollution is numbered amongst them.

I would strongly emphasize that the foregoing comments are not in any way intended to be a criticism of the work being done by the Alkali Inspectorate. On the contrary, it is because I am convinced that they are performing a very difficult task in an extremely efficient manner that I feel that everything possible should be done to make as widely known as possible the success which they are achieving.

Special Problems

(*a*) *Cold Blast Cupolas*

Every Public Health Inspector to whom our questionnaire was addressed and in whose area there were iron foundry cupolas, expressed the opinion that these represented one of the most difficult grit and dust pollution problems of his district. Cupolas have always been notorious for their grit, dust and fume emitting propensities, and it was not until the inception of the Clean Air Act that any large scale attempt was made to tackle the problem, although a lot of spark arresters were fitted to cupolas at the beginning of the war. This was done for the purpose of hiding glare, rather than for the prevention of grit emission.

As you will be aware, there is theoretically a wide choice of appliances now available for this work. At the bottom of the range there is the simple dry arrester which is relatively cheap to install, but which will only arrest the larger particles of grit, but with the best of these types one cannot hope to arrest more than 25–30 per cent. of the emission by weight. With the poorer type of dry arrester the rate of arrestment may be very much less than this. But even with the best type the size and amount of the material not arrested can be sufficient to cause serious nuisance.

Further up the scale we have the wet type of arrester, of which again there are varying types with varying degrees of efficiency. Generally speaking these are more expensive to install than most simple dry arresters, and greater running costs are involved. With an efficient wet type arrester 50–60 per cent. of the grit and dust is likely to be collected, and it is claimed that virtually all particles down to grit size (76 microns) will be collected and a substantial proportion of dust smaller than this. It is said that complaints of grit and dust usually cease when wet arresters are fitted and properly maintained. Unfortunately, neither the dry nor wet type of arrester have any visible effect on fume or smoke.

To deal with fume and smoke, or to achieve higher degrees of dust arrestment involves the use of the more efficient types of equipment such as electrostatic precipitators, fabric filters or venturi scrubbers. Unfortunately, these are much more expensive than wet arresters, possibly costing ten times as much or more, and the cost of installing them could well exceed the cost of the plant to which they were to be fitted.

In the light of the technical background, the administrative officer is faced with the problem of basing his recommendations or requests upon what are "the best practicable means". In 1958 a meeting took place between representatives of the Council of Ironfoundry Associations, and representatives of Local Authority Associations at which the industry expressed the view that a wet type grit arrester was reasonably practicable for cupolas

TABLE 1.

Cupolas Melting less than 500 tons of Metal per Year				*Cupolas Melting more than 500 tons of Metal per Year*			
No. of Cupolas	*No. fitted with dry type arresters*	*No. fitted with wet type arresters*	*No. without arresters*	*No. of Cupolas*	*No. fitted with dry type arresters*	*No. fitted with wet type arresters*	*No. without arresters*
180	115	6	59	469	209	198	62

working at least 1,000 hours per year, but for cupolas working less than 250 hours per year they considered that simple dry type arresters should be sufficient. These were of course the views of the trade, and it is important to note that no agreement either formal or informal was arrived at between the two sides. I understand that the Local Authority representatives were prepared to accept that in some local circumstances the dry type arresters might be deemed to be adequate, but stressed that they could not preclude Local Authorities from requiring more efficient arresters, having regard to particular circumstances. Whilst recognizing that some gas cleaning methods, *e.g.* cyclones, bag filters, electrostatic precipitators could be far too onerous in capital outlay and running costs for small plant, the importance of local circumstances demanded a clear distinction between existing and proposed plant. They further recognized the difference between the costs of wet and dry type arresters and the particular significance of the economic factor to small plants, but did not agree that the dry type arresters would be sufficient simply because of infrequency of use of cupolas or relatively low tonnages of metal being melted. Local circumstances were equally important.

Nevertheless it does seem as though in practice the suggestions made by the trade are being followed. According to information supplied by 44 Local Authorities, the present position is as shown on Table 1.

According to the information received, many Local Authorities are busily engaged on action to get wet type arresters fitted on the larger cupolas, and one may expect the position to improve steadily over the next few years. In a number of cases Chief Public Health Inspectors have expressed a reluctance to ask for wet type arresters which they feel necessary to prevent grit emission because they fear that the resultant temperature reduction of the used gases and their admixture with water vapour may accentuate the nuisance from fume, and they do not wish to abate one nuisance at the expense of causing another.

It is interesting to note the comparatively large number of cupolas, especially those of the smaller type which are entirely without arresters. It seems that in some areas where cupolas operate without causing complaint from the community, it is not considered necessary to require the provision of grit and dust arresters. There is a lot to be said for the old adage about "never troubling trouble till trouble troubles you", but this is not the way to clean up the atmosphere. We know that cupolas are by their very nature grit and dust emitters, and Section 5 of the Clean Air Act requires that all plant capable of emitting grit and dust, must be fitted with the best practicable means of preventing such emissions. It must follow that when there are cupolas without arresters, the Act is not being enforced.

There would appear to be a definite need for a greater degree of uniformity of action by Local Authorities. Industry has to compete in the same markets, and there would undoubtedly be a more ready acceptance on its part to provide the new equipment required if they could be certain that every other firm with similar circumstances was being treated in the same manner.

Is not this difficult question of controlling emissions from cupolas a matter which might well be studied by the Ministry or the Clean Air Council with a view to the issue of guidance for Local Authorities? If it can be done on chimney heights, why not on cupolas?

In the Midlands, the Midlands Joint Advisory Clean Air Council and the Council of Ironfoundry Associations have been having joint discussions on this problem, and I understand that recommendations have been issued on the following lines:

Practicable Means for Suppressing Grit and Dust from Cold Blast Cupolas

1. Cupolas worked up to 250 hours per annum—Dry Arrester.
2. Cupolas worked between 251 and 750 hours per annum—Wet or Dry Arrester subject to site conditions and local circumstances. All new Dry Arresters must be capable of easy conversion to Wet Arresters.
3. Cupolas worked for 751 hours or more per annum—Wet Arresters (except where water supplies are not available).

Explanatory Notes Concerning the Recommendations

In a comparatively small number of instances, particularly where dirty scrap is melted, although there is a diminution of grit and dust brought about by the fitting of a wet arrester, there may still be an emission of smoke.

Whilst there will be a reduction in the emission of grit and dust by the use of wet arresters, it is pointed out that this is only a guide to meet the requirements of Section 5 of the Clean Air Act, 1956, and the question of the adoption of the recommendations in a particular instance is a matter for the decision of the Local Authority on the advice of the Chief Public Health Inspector.

Although, as is mentioned above, the wet type arrester offers a considerable improvement over the dry type of arrester with a baffle, it is not intended that the wet arrester shall preclude any installation which may be developed in the future having regard to the definition of "practicable" used in Section 5 of the Clean Air Act, 1956, and defined in Section 34 (1) as "means reasonably practicable having regard amongst other things, to local conditions and circumstances, to the financial implications and to the current state of technical knowledge", and "practicable means" includes the provision and maintenance of plant and the proper use thereof.

One hopes that the operation of these recommendations will be watched with close interest by the Ministry, as it may prove to be a large scale pilot scheme which could form a basis for the issue of advice by them for the whole of the country. All parties concerned are to be congratulated for their efficiency and enterprise in endeavouring to tackle this thorny problem.

(*b*) *Iron and Steel Works*

The general impression gained from the observations made to me by Chief Public Health Inspectors of areas in which iron and steel works are situated, is one of reasonable satisfaction with the rate of progress being made in the installation of efficient arresting equipment. It is particularly pleasing to note the ever increasing number of electrostatic precipitators being fitted, although it has to be remembered that many of these are being installed to deal with the red-brown chimney plume associated with the use of oxygen in steelmaking. One trembles to think what the position might have been had these processes been instituted before the operation of the Clean Air Act. It has been suggested that in time the classical open-hearth process will have gone for ever, and we may assume from this that they will be replaced by oxygen using processes which will necessitate the use of high efficiency cleaning units. But this may take a long time, and one wonders if any steps are going to be taken in the meantime.

Several officers are concerned about emissions from sinter plants, and there are one or two others who state that their local sinter plant problem has been solved by the installation of electrostatic precipitators. Is this the answer for the others? Whether it is or not, it is certainly one of the kind of problems which could be discussed between the Local Authority and the Alkali Inspector, if the type of consultation which I have mentioned previously could be set up.

Whilst obviously much remains to be done, and much money will have to be spent before the iron and steel industry can be regarded as no longer making a considerable contribution to atmospheric pollution, it would be unfair to fail to recognize and mention the splendid start which they have made. In my own area of Tees-Side, the amount of money expended so far by industry to combat atmospheric pollution is many times more than the expenditure by Local Authorities, Central Government and householders on domestic smoke control.

(*c*) *Electricity Generating Stations*

Some 20 officers reported that grit emissions from electricity generating stations represented a problem in their areas. In 16 cases electrostatic precipitators were in use; in 2 cases other types of arresting equipment were in use, and in 2 cases there was no equipment in use. In a few cases the use of arresting equipment had been combined with increased chimney height.

In every case but one the officers expressed the opinion that a problem still remained. In the odd case the officer felt that as the grit arresting equipment had only recently been modified, it was too early to express an opinion. In two areas the plant was to be converted to burning fuel oil.

(*d*) *Cement Works*

The information obtained about cement works is confined to those on Thames-side, but it seems that considerable progress is being made there. By the end of the year all kilns are expected to be fitted with electrostatic precipitators, and those with a "slip" of more than 0·5 per cent. are to be replaced. The installation of dust recording apparatus is to be given a trial. If this is carried out it should hold out hope of an improvement in an area which has for a long time suffered severely.

(*e*) *Other Sources*

Serious grit and dust emissions were reported from a wide variety of other sources. These included:

Granite quarries.
Shot Blasting, Grinding and Polishing.
Grinding Works.
Wood dust from chipboard factory.
Concrete making plant.
Coke ovens.
Slag Crushing Plant.
Hot Blast Cupolas.
Wood ash and sawdust.
Grain and Flour dust.
Works Incinerators.
Railway Goods Yards.

With but a few exceptions, the officers reporting considered the problems arising to be more of a technical nature than of an administrative character. It is interesting to note the list of premises from which grit and dust has been emitted, as it is important to know where risk of pollution lies. If new premises are to be brought into operation, Town Planning consent is required, and before such consent is given in the case of processes of the type mentioned above, it is most important to ensure that the premises are suitably sited and properly equipped to prevent nuisance. Subsequent action to revoke planning consent can prove very costly to the Local Authority, and it is far better to be wise before the event.

Determination of Sources of Emission

Little difficulty appears to be experienced by officers in determining individual sources of emission, and there is apparently equally little difficulty in convincing Industrialists that their plant is responsible. Where grit is concerned, it is frequently only too evident in the actual area of the works concerned. Where proof has been necessary, this has usually been done by the use of Petri dishes, or glass plates treated with light oil and varnish or standard deposit gauges. Often the material collected is examined microscopically, or subjected to analysis.

Trends in Pollution

34 of the Authorities approached had maintained standard deposit gauges for some years in industrial areas, and were asked whether the trend of deposits over the past seven years had been upwards, downwards or static. In 25 areas the trend was downwards, in nine areas the position was static, and in no area was the trend upwards. One area reported that a gauge near to which a sinter plant had been placed showed an upwards trend, and a similar result was produced by one gauge near to a steel works.

A special study recently carried out on Tees-Side of the results of deposit gauges which had been on the same sites for at least 10 years, showed that there had been a reduction in insoluble deposit in industrial areas, of 17 per cent during the first five years after the coming into operation of the Clean Air Act.

The general picture would appear to suggest that much of the work which has been done since 1956 is bearing fruit in the shape of decreased deposits.

Since the introduction of the national survey of smoke pollution there has been an increase in the use of volumetric air filters, and a consequent falling off in the use of standard deposit gauges. Whilst one cannot fail to be delighted at the increasing use of air filters to give an accurate estimation of smoke pollution, one cannot help feeling that in areas where grit and dust is also a problem, the standard deposit gauge has still a part to play. Where they have been used on the same sites for a number of years, there is much to be said for keeping them there.

General

The small survey which I have been able to carry out suggests that there is a growing awareness on the part of all convinced of the importance of efficient control of grit and dust emissions. A good start appears to have been made by both the Local Authority Inspectorate and the Alkali Inspectorate in dealing with the problem. From the Local Authority side it is most encouraging to note the ever increasing number of Public Health Inspectors showing their practical interest in problems of atmospheric pollution by studying for the Smoke Inspector's Diploma of the Royal Society of Health. It is a matter of regret that in many cases their enthusiasm and effort does not receive any financial recognition.

Taken generally, the legal provisions are working reasonably satisfactorily, although in some cases capable of improvement, in the light of experience gained. Difficulty still exists in getting over to the general public, information about the progress which is being made.

Mention has previously been made of my appreciation of the kindness of those Chief Public Health Inspectors who provided me with so much useful information. An equal debt of gratitude is due to many Industrialists, manufacturers of arresting plant and other experts who have given me the benefit of their experience and advice.

Discussion

R. Emerson (West Hartlepool) in opening the discussion, said that in dust control neither the administrator (in the form of Mr. Sugden) or the engineer (represented by Mr. Short) ought to be complacent.

So long as a housewife suffered from dust nuisance she would be more pleased if the source of the dust were to be removed than if smoke in the town was reduced, although Mr. Emerson accepted the medical view that the smoke might be the more dangerous to her health. In a recent comment about a certain dust nuisance, the press had given three views. A housewife said it wasn't good enough; the engineer said that he couldn't be blamed because the electrostatic precipitators at the plant were 99·6 per cent efficient; and the administrator said that legally nothing could be done so long as the firm took the best practicable means. They were all right—but the fact remained that the problem had not been solved.

The first major step in preventing that type of trouble was in planning and Mr. Sugden might have mentioned how increasingly imperative it was that public health inspectors of local authorities should be consulted by the planners before approvals were given to the erection of plants likely to cause smoke or dust nuisance. In county boroughs no difficulties should arise in this respect, and Mr. Emerson liked to think that all were like his own where that arrangement had been working satisfactorily for some years. There was no doubt that if the planning authority made a mistake, it was the Health Department who would have to sort out the complaints.

Mr. Emerson was interested to learn from Mr. Sugden of the close co-operation between Public Health Inspectors and Alkali Inspectors and in his suggestion of closer co-operation with the local authority members. There seemed no doubt that Alkali Inspectors were doing a good job. His only slight reservation was that year after year they reported no prosecutions at all and it was hard to believe that there were no black sheep. However, there was no doubt that there had been substantial improvements and whilst progress might not be as quick as some would like, it was being achieved with a good deal of goodwill. It was clear from the Chief Alkali Inspector's report that their aim was to try and reach agreement with industry at national level and it was interesting to see in Mr. Sugden's paper that similar discussions had taken place in the Midlands by local authority representatives on the problem of cupolas. Surely this was the sort of co-operation we wanted, the preparation of national standards acceptable to industry and the representatives of the public.

Referring to the paper by Messrs. Clegg and Short, which he thought would be used as a text-book by many public health inspectors and industrialists, Mr. Emerson would have liked an indication of the actual types of plants that they recommended should be fitted with the various types of collectors. Their paper thus enlarged, could perhaps have formed the basis for further national standards.

Plants which created dust, otherwise than by combustion, seemed to have been a bit neglected by the dust suppression people and by the authors of both papers, but so often, even if dust arresting plant was installed, a nuisance arose on windy days from the dust created by lorries moving about on dusty roads and from spillage. Mr. Emerson wondered why, for instance, makers of road materials never bothered to make proper roads on their own sites, which could be swept up from time to time. What was the use of expensive equipment to stop dust billowing out of a chimney if the site was so badly kept that on the first dry windy day the place looked like a sandstorm?

On the question of measurement of dust pollution, in the last paragraph of Mr. Sugden's paper in the first column on page 108, he stated that 55 authorities out of 75 had admitted to a dust problem, but in discussing the trends of pollution on page 117, it was revealed that only 34 authorities maintained deposit gauges. If that were really correct, it seemed rather regrettable that so many authorities had given up using this gauge. Whilst it had its limitations, if its results were used intelligently, it could give a good guide to trends in dust pollution locally, which was undoubtedly useful information. Mr. Emerson appreciated the Department of Scientific and Industrial Research point about the information not being of much use for a national survey, but locally, the results could be most useful and he rather deplored their loss where dust was a problem.

Both papers had made reference to the new memorandum on chimney heights and all had to welcome the Ministry's action in publishing such a useful standard. In Mr. Emerson's experience the standards required by this memorandum meant rather higher chimneys in the smaller plants such as schools, offices, public buildings, and in our desires for clean air we had to remember the aesthetic considerations. As Dr. Reed had said, there were many examples of excellently disguised chimneys for this type of building. He thought that this society—perhaps in co-operation with the architectural organizations—could publish photographs and ideas of how the two ideals could be achieved at the same time.

On chimney heights Mr. Emerson asked Mr. Short whether in a boilerhouse situated below ground level, the chimney height as calculated from the memorandum should be measured from ground level or whether some allowance should be made for that part of the flue below ground level.

The amount spent by industry on the suppression of atmospheric pollution was extremely high and without minimizing what had been done, Mr. Emerson thought it should be increased, particularly in some industries. The total number of houses in smoke control areas up to April was just over a million, and if the conversion averaged £15 a house, the total exchequer grant would have been six million pounds. According to the figures given by Mr. Britten in his paper, that was only just over twice the amount spent or about to be spent by one division of the I.C.I. on combating air pollution; these figures surely had to make us think. There was only one way to tackle air pollution and that was on all fronts at once. All forms of pollution—smoke, dust, grit or fumes had to be reduced to the limit of technical knowledge available and these papers had shown us something of the ways of tackling one of the problems.

F. M. Shaw (The British Cast Iron Research Association) said that Mr. Sugden had quite rightly drawn attention to the problem of emissions from cold blast cupolas. This was a problem about which the ironfounding industry was also well aware. It was being tackled and many complaints had now ceased due to the installation and proper use of suitable grit arresters. Smoke remained but had been removed by combustion in specific cases by varying the charging methods, materials and cupola design. The smoke was caused by oil, paint, etc., inevitably present in the scrap which had to be melted. The fuel, being metallurgical coke, was smokeless. Because of the nuisance that highly contaminated scrap could cause this was now voluntarily refused by most foundries, with the result that more expensive scrap had to be bought instead. It would be instructive to know what would eventually happen to this scrap. An interesting point here was that some of the worst scrap available—destructor scrap—was sold at a profit by some local authorities, though fortunately it was not used in the cupolas of ironfoundries.

Cupola smoke could sometimes be burned in the cupola, but this resulted in having to run the cupola inefficiently, and thus increased the cost of the iron produced. This, and the refusal of dirty scrap, were among the many financial pressures which bore with particular severity on small foundries, which were closing at the rate of one per week; thus some of the industry's most intractable emission problems were solving themselves.

Mr. Sugden put smoke and fume together as forming the same problem. However, visible metallurgical fume, unlike smoke, could not be burned, it could only be collected. Only electrostatic precipitators or equivalent were capable of collecting such fume, and the cost was about ten times that of fitting a wet arrester, which was itself a highly expensive item for the smaller cupolas.

As to what type of arrester should be fitted to cupolas, Mr. Sugden mentioned the 1958 suggestion that all cupolas running for more than 1,000 hours per year should have wet arresters. The more recent agreement between the industry and the West Midlands Joint Advisory Clean Air Council now called for wet arresters at the 750 hours level. Thus progress was being made. The latest agreement was an excellent example of what goodwill and understanding by both sides could achieve. In the West Midlands area this agreement should go a long way towards solving the grit problem and Mr. Sugden very rightly commended the agreement.

The cupola gases were cooled by passing through a wet arrester but still emerged at 250-400°C. if combustion occurred—higher than from an efficient boiler plant. If no combustion occurred the temperature was likely to be under 100°C. before and after the arrester. We had no evidence that the gas temperature adversely affected dispersion—in fact, the only evidence indicated that gas temperature made no difference to the dispersion of cupola gas. This was probably because the total amount of heat was relatively small when compared to, say, power station gases where temperature certainly did affect dispersion. The addition of water vapour on passing the wet arrester increased gas buoyancy contrary to commonly accepted ideas—though the effect was small.

Responsible opinion in the industry accepted that some form of arrester should be fitted to all cupolas, and indeed, there was a legal requirement to do so (Section 5, Clean Air Act). However unless customers were prepared to pay more for castings, the cold blast cupola effluent problem would never be completely solved. A further point which had to be made was that we were in direct competition with Continental foundries. If the British industry was expected to reach higher air pollution standards than obtained in Europe, we should be at an economic disadvantage. Fortunately, Continental standards, which were formerly less stringent than ours, were beginning to rise. Co-operation on this problem now existed under the European Committee of Ironfoundry Associations, whereby the experience of particular countries was placed at the disposal of all members. This applied not only to technical matters but covered economic and legal aspects as well.

Considerable pilot plant and full scale work was being done in this country on both hot and cold blast cupolas' emissions, consequently the design data now available was far better than it had been only five years ago. It would be seen therefore that while the cold blast problem still existed much had already been done and much more would be done in the future.

Dr. R. Jackson (British Coal Utilization Research Association) said that there were a large number of points that could be raised in these two papers and also in the comments of Mr. Emerson. He applauded a great deal of what they said but some of it he rejected. There were two points which he wished to raise; one from each of the papers.

Turning first to Mr. Sugden who wanted the implementation of the Act as it regarded measurement of emission. While Dr. Jackson would have liked the results of those measurements to be made available he wondered if Mr. Sugden realized what that would in fact imply. The Act laid the burden of measurement on the owner of the plant, and there were possibly, as far as boiler plant were concerned, 10,000 owners. The day before, Mr. Crow had made an appeal for means of continuous measurement of the emission of solids. At the present time any equipment of that type did not exist. That left at the present time individual measurements by dust sampling. There were two ways in which the owner could deal with that, either by doing it himself or by getting someone from outside. If he did it himself he started by having to buy the equipment, which cost not the £400 mentioned by Mr. Sugden but something rather over £100. As soon as he got the equipment he then had to have a man to use it; he did not need a graduate engineer or a physicist but he needed a trained technician. Dr. Jackson asked how many small owners had a trained technician and if they had whether they could liberate him for this job and train him. A technician had to be able to do the job; he could go to a training course but no training course existed. At the most a training course might be able to deal with 50 people a week; with 10,000 people to be trained, this was going to take a long time. An owner might try to read the thing up himself, he could take B.S.893 as his standard which was very complicated as it applied only to power stations. Alternatively he could take the more recent one B.S.305, the simplified method; this he might be able to understand but some of the terms needed explaining and it was of limited application. As another alternative he could try to read a number of papers published on the subject which would probably be difficult for him to understand. There was only one good text book on the subject of dust sampling which had been published by B.C.U.R.A. Having done all that an owner might give it up as a bad job, and call in an outside expert team. At the present time the number of organizations who could undertake this kind of work could be counted on the fingers of one hand. They would be unable to cope with 10,000 tests per week, or 10,000 tests per year, and possibly 10,000 tests per ten years. Dr. Jackson wondered about the solution to the problem and suggested that it would be more reasonable for the local authority to try to do the job themselves. They should not act as judge and jury but rather in the way of the Alkali Inspector as a kind of father-confessor. This would be a much less difficult problem because with 1,000 local authorities, reduced by grouping possibly to 200 or 250, it would be quite a reasonable job to train sufficient smoke inspectors to do the measurement of grit emission reasonably accurately. There would be the added advantage that they would realize what the true nature and magnitude of the problem was and get on good terms with the plant owners to help them.

With regard to Mr. Short's paper and his reference to maintenance, Dr. Jackson wished to emphasize that a plant had to be maintained; if it was not maintained it did not work efficiently, and might as well not be put in. Works engineers quite often seemed to have a blind spot on this and failed to realize that a dust collector collected dust; too often they forgot this and seemed to think that the dust just disappeared. It did not disappear, it either went into the hopper and then the hopper had to be removed or emptied or it went up the stack. If the hopper was not emptied from time to time it was useless and this applied probably to 50 per cent of the plant in the country.

Mr. Emerson had said that he would like Mr. Short's paper expanded. B.C.U.R.A. had done this and had quite recently published a book entitled "Mechanical Equipment for Removing Grit and Dust from Cases"; this book was on sale in the Exhibition.

Dr. Jackson said that these were his personal views and did not necessarily commit the B.C.U.R.A.

H. E. T. Lowbridge (Willenhall) said that he was pleased that Mr. Sugden had included in his paper the recent agreement made between the Council of Ironfoundry Associations and the Midlands Joint Advisory Clean Air Council.

A large proportion of the cupolas in this country were situated in the West Midlands, and the Midlands Joint Advisory Clean Air Council was concerned with the slow progress which was being made to comply with Section 5 of the Clean Air Act and of the need for the fitting of a wet type of arrester for suppressing grit and dust, Mr. Lowbridge quoted the example of a cupola in his experience which was fitted with an ordinary dry type of arrester with a baffle and the amount of grit and dust collected was 5 to 6 lbs. per ton of metal melted. When fitted with a wet arrester the amount of grit and dust collected was 30 lbs. per ton of metal melted—an increase of 5-6 times.

He said that he was on the roof of a factory a few weeks ago where replacement of dry arresters with those of the wet type was in progress and the grit and dust was a foot deep.

When the Midlands Advisory Clean Air Council were considering a standard to be adopted they surveyed the problem (took an all round look) and decided that the number of hours which the cupola worked was the best on which to base a standard.

The external diameter of the cupola offered no guide as the thickness of the lining varied considerably and could not be easily measured. Tonnage of metal melted seemed to offer a reasonable prospect but was variable (as was for that matter an hourly basis), but an agreement on tonnage was not likely to include many small cupolas which might emit fairly large quantities of grit and dust. The number of hours worked per year was decided upon as the basis for an agreement as this would include numerous small cupolas, which might not be included as already mentioned, if reckoned on a tonnage of metal melted basis.

Mention had been made in the paper of a meeting in 1958, with representatives of the Council of Ironfoundry Associations and representatives of Local Authority Associations and the meeting suggested that cupolas working more than 1,000 hours should have a wet arrester. It would be observed that the Midlands Joint Advisory Clean Air Council's agreement with the Council of Ironfoundry Associations was a considerable improvement over this in that cupolas working over 750 hours per year had to be provided with a wet arrester.

Mr. Lowbridge also said that there was no reliable test as far as he knew of checking the grit and dust output from an open topped cupola.

J. H. Burrows (Eston) said that he would not refute the statement in Mr. Sugden's paper that industrial emissions had shown a downward trend. This applied to an overall picture of Tees-Side up to 1961 and in recent years Mr. Burrows' Authority of Eston had received a concentration of industry within its boundaries which now gave rise to some serious concern in relation to emissions from the iron and steel producing industries.

This concern arose from evidence obtained from that "old fashioned" but faithful instrument the deposit gauge, which the members of the Tees-Side Clean Air Committee had agreed should be kept in existence within the constituent authorities for the purpose of monitoring gross pollution. It was agreed that analyses figures should be based on "short type" with the inclusion of a "ferric oxide" determination within the insoluble solid figure.

His own authority were most concerned because these deposit gauge figures for Eston had shown an upward trend for the year 1962 and this figure was still soaring upwards for the first six months period of 1963. In addition the ferric oxide determination in all five Eston gauges within industrial and residential belts indicated 12-33⅓ per cent on average of the insoluble solid figure.

Therefore whilst the majority of the processes in these works were within the purview of the Alkali Inspector, an officer for whom Mr. Burrows had the greatest respect, it was his view that serious pollution arose in the main from three sources:

1. Coke Oven Practice;
2. Ore Sintering Plants; and
3. Open Hearth Furnaces with their latest acquisition of oxygen lancing.

With regard to coke ovens, and comparing within the Eston area emissions from pre-war constructed ovens (1936) with those of post-war batteries constructed some five years ago, in both cases serious emissions occurred, especially during oven charging, oven discharging and coke quenching processes. Heavy clouds of carbonaceous matter and sulphur compounds were liberated to atmosphere and the process of coke quenching with its high water vapour content and fine coke particle dissemination left much to be desired. The whole process was dirty, was a major source of atmospheric pollution and very little improvement in connection with emission control in this industry had been exercised over the past 25 years. This therefore appeared to warrant serious attention by this Society.

Regarding ore sintering within the past few years in the Eston area it had been a great relief and pleasure to see a most inefficient sintering plant which proved to be a pollution headache replaced with an up-to-date plant incorporating modern de-dusting equipment.

Proof of the possible efficiency of modern plant in the clean air field had been demonstrated in the case of this particular plant as very few complaints had been received in the Health Department since its introduction and in spite of the proximity to residential area. However, oil sintering plants needed to be of modern construction today and old offending plants—and there were still some in existence, should be scrapped and replaced with new.

With regard to open hearth furnaces, with the recent advent of oxygen lancing in steel production the atmosphere within Mr. Burrows' own area, and no doubt that of others, had been charged with those reddish brown plumes ($Fe_2 O_3$) which were most effectively distributed by wind movement to be finally deposited over residential areas many miles from source.

He had been assured that electrostatic precipitators were to be provided in this process to combat this nuisance, but wondered how long we would have to wait for a successful outcome.

Industry within the district of Eston was spending many thousands of pounds on de-dusting equipment but it would appear that the use of equipment in this process was as yet in experimental stage. One had to exercise patience, but this conclusion was hardly sufficient in assisting those local authorities within iron and steel districts who were directed by the Ministry to implement smoke control areas and in this field public opinion had to be with the Authority to obtain real success.

He thought that industrialists could make note of Mr. Sugden's point in his paper asking them to publicize their efforts in clean air production, as the public should be made fully aware of industry's efforts in the clean air field.

He was fully confident that the industry would succeed in the fields mentioned just as they had done in blast furnace practice which today was most efficient and was playing its part in the clean air movement.

A. M. Hunter (Chemical Construction (G.B.) Limited) commented on the venturi scrubber referred to in the first of the two papers and stated that the pressure drop quoted indicated that the flexibility of the venturi scrubber was probably not fully understood. He stated that the venturi scrubber might be used for collection of both sub-micron and plus-micron size particles, and the pressure drop would depend on the cleaning job it was desired to do. He also stated that where fine metallic oxide fumes, such as those produced by oxygen steel-making processes, were collected and overall efficiencies to give exit loadings below 0·05 grains per standard cubic foot of dry gas were required, the pressure loss could be as high as 30 in. water gauge or more. If it was only intended to collect grit and plus-micron dust with efficiencies above 99 per cent, Mr. Hunter stated that it was certainly not necessary to use the 10 in. water gauge referred to in the paper and he also asked the author to tell the conference on what performance the figure of 10 in. water gauge was based.

The conference was informed that when designing a venturi scrubber the pressure loss was determined in the light of the scrubbing job required to be done and the higher the pressure drop used, the better was the grade efficiency curve. The conference was further informed that even with 3 in. water gauge pressure drop a grade efficiency curve could be obtained that would be better than any appearing in the paper.

The final observation made by Mr. Hunter was that loss of plume buoyancy was often given as the reason for objecting to wet scrubbing, but in many instances a high degree of acid gas absorption could be obtained, particularly when an alkali wash was used; this, together with the higher grade efficiency curve of the venturi scrubber when operated with the pressure drop of dry collectors, should be taken into consideration when determining the concentrations of pollutants at ground level.

F. E. Ireland (Alkali Inspectorate) congratulated the speakers on the way they had presented their papers and said he was especially interested in what Mr. Sugden had to say as he had intended to raise some of these matters himself. On the question of responsibility for industrial pollution some speakers in the discussions gave the impression that all industrial pollution was the responsibility of the Alkali Inspectorate and the local authorities were only responsible for domestic smoke. This was not the case. Slightly more than 2,000 works were registered under the Alkali Act, admittedly the major potential offenders with many difficult technical problems, whilst local authorities were responsible for emissions from some 20/30,000 works. It was the declared policy of the Inspectorate to maintain a close liaison with local authorities in whose areas there were registered works. Routine visits were paid to the Health Departments at least two or three times per year and many more when complaints were brewing. The local authorities were the guardians of the air in their districts and were responsible to their electors whether works were registered or not. It was only right that they should be kept aware of what was happening at works under the control of the Inspectorate.

Mr. Ireland disagreed with Mr. Sugden's statement that Section 10 of the Clean Air Act did not apply to plants controlled under the Alkali Act. He maintained that Section 10 applied to new chimneys for which planning permission had to be sought under the building bye-laws, whether such plants were registrable under the Alkali Act or not. (In a written contribution and in reply to Mr. Sugden's summing-up at the end of the discussion, Mr. Ireland explained that new plants which were *registrable* under the Alkali Act could not be *registered* until the plants were completed and fitted with the agreed "best practicable means". Until the plants were registered the Inspectorate had no statutory powers of control and the local authority were responsible for seeing that Section 10 was applied.) It was the Inspectorate's invariable practice to inform the local authority concerned when they made a request for a new chimney for a registrable works and of the reasons for choosing the particular height. There was often a conflict of ideas between the planning and health departments of local authorities, the former sometimes saying that a chimney was too high for aesthetic reasons and the latter that it was too low for health reasons and it was often difficult to reach a compromise. Mr. Ireland also commented on Mr. Short's statement about maloperation of plant and cited a case at a power station when an operator lighting a boiler from cold carried out the drill perfectly, except that he forgot to apply a light to the fuel and the neighbourhood was showered with pulverized fuel.

The C.E.G.B. offered to pay cleaning bills. This incident was merely one example of many incidents caused by breakdown or maloperation of plants giving rise to justified complaint. The Inspectorate had been criticized for the smallness of its staff and lack of court action in dealing with offences, but incidents such as that described could not be avoided by a host of inspectors nor would any good have resulted by public punishment of the C.E.G.B. Mr. Ireland drew attention to the information on grit and dust in the opening paragraph of Messrs. Clegg and Short's paper and added that the smallest, individual particle of dust which could be seen with the naked eye was about 10 microns diameter whereas the largest size of dust which penetrated to the lungs was only of the order of a few microns. He said he would like to see at these Conferences an informed statement in layman's language of what happened to the various sizes of dust particles which were inhaled through the nose. Mr. Ireland apologized for having to correct a statement by the President about renewal of registration annually under the Alkali Act. Once a works was accepted for registration under the Alkali Act, annual renewal of the certificate could not be refused because a works did not continue to use "best practicable means". On the contrary the Inspectorate would be failing in its duty if it allowed such a thing to happen. Recourse could be had to legal action if a works refused to comply but happily this had not been necessary for many years.

County Alderman J. A. Gavin (North Riding of Yorkshire C.C.) stated that the conference had dealt far too politely with industrialists generally and the steel industry in particular. Too much emphasis had been placed on the amount of money that had been spent on equipment for air cleansing, and not enough on (*a*) whether the machinery was effective; (*b*) if it was being used as it should, and if it was being maintained in good operative condition.

It had been hoped that dust produced due to the process of oxygen lancing could be returned to the system in the form of sinter. This had not been found to be a practical proposition and as a consequence huge accumulations of dust were embarrassing steel manufacturers not only from the point of view of the accumulation but also this dust was being re-introduced to the atmosphere by the wind, thus defeating the object of extraction at source. Was it then likely that extractors would be working 100 per cent if their operation was the cause of considerable nuisance? He ventured to suggest that there would be times, in the dark hours for example, when they might "conveniently" be switched off.

He had been pleased to note that mention had been made of slag crushing, this was a lucrative ancillary of the steel industry that could afford more protective measures than it presently supplied and was by way of becoming one of the worst offenders.

Finally he queried the optimistic note that had resulted from the statistics showing a reduction and reminded the author that the steel industry had been in a state of recession since early in 1961 and it was to be expected that some reduction should be apparent.

F. F. Ross (Central Electricity Generating Board) referring to Mr. Sugden's findings on electricity generating stations, said that the C.E.G.B. had on their hands a number of old plants built by private companies and by local authorities; they also had plants designed 10 or 12 years ago, containing equipment which was as good as it could be at that time. The problems were technical and, with experience and research, technique was improving. They did not wish to pretend there was no cause for complaint. They could, however, claim to be working hard on the problems.

Mr. Sugden, in replying to the discussion, thanked all those who had taken part in it. The chief value of conferences of this type was the fact that they provided a forum at which mutual problems could be discussed, and he always felt that the fuller the discussion, the more successful the proceedings. That morning's discussion had confirmed him in his views.

Mr. Emerson had stressed the point that plants which created dust other than by combustion, appeared to have been a bit neglected in the paper. In so far as this was true it was due to the fact that there appeared to be so much less information about it, and this obviously supported Mr. Emerson's plea for more attention to be given to this particular type of nuisance.

Mr. Sugden agreed with Mr. Emerson that it was imperative that the Public Health Inspector should be consulted by the planners before approvals were given to plants likely to cause smoke or dust nuisance. Indeed, during his inquiries before preparing the paper, he had been told of a case where planning approval was given to a plant without any consultation with the Health Department. Immediately the plant was operated, an intolerable nuisance arose and the local authority was having to consider the re-siting and transfer of the plant at their own expense.

He agreed with Mr. Emerson that in areas where there was known or believed to exist dust or grit nuisances it was a wise policy to continue to maintain deposit gauges, and it was disappointing to see that some such Authorities had abandoned their deposit gauges. This was probably due to some extent to the enthusiastic way in which the Department of Scientific and Industrial Research had set about persuading local authorities to install air filters which were quite rightly described as being the most efficient and up-to-date instruments for measuring smoke. There was a need in most industrial areas for both types of appliance, and this was especially true of areas where they already had deposit gauge records dating back for several years.

Mr. Shaw had had some encouraging things to say about the progress which had been made in the discovery of methods of dealing with nuisance from cold blast cupolas, and it was pleasing to know that design data now available was far better than it had been as recently as five years ago. Mr. Sugden thought that whilst it would not be unreasonable to suggest that the passing of the Clean Air Act had played a considerable part in encouraging this research and investigation it did none the less show that the ironfoundry industry was not merely wanting to sit back and emphasize its own particular difficulties, but was getting down to the task of overcoming them.

Whilst in some ways he was sorry to hear that the difficulty of meeting requirements to prevent grit and other emissions was playing a part in causing the closure of many small foundries, one had nevertheless to face the economic facts of life. At any given moment in any industry in an uncontrolled society there were marginal firms only just managing to exist, and who were liable to be forced out of existence as the more efficient firms increased their efficiency still further. Wasn't the fact that this was happening perhaps the industry's best long term answers to the problems of foreign competition to which Mr. Shaw had referred.

Mr. Sugden thanked Dr. Jackson for his detailed explanation of the difficulties inherent in any attempt to organize routine dust sampling from industrial plant. He reminded him, however, that he had merely suggested in the paper that endeavours should be made to get a scheme started in a limited number of plants, and what he had had in mind had been the larger plants. He felt that the larger firms might well have the staff and resources for this work. There seemed to him to be a better chance of more people being trained for the work if it was known that there was a chance of the necessary skill and knowledge being utilized. He was, however, very interested in the suggestion that local authority Smoke Inspectors might be trained in the work, and he felt that this was a method of overcoming some of the difficulties which might with advantage be given more detailed consideration.

Mr. Sugden expressed his pleasure that Mr. Lowbridge had joined in the discussion, because everyone knew of his excellent work with the Midlands Joint Advisory Clean Air Council on the subject of cold blast cupolas. He had been particularly interested to hear his explanation of the reason why the number of hours a cupola worked was chosen for the purpose of fixing standards. Mr. Lowbridge has shown how the amount of grit collected, could be increased by 5 to 6 times when wet arresters were fitted in replacement of dry types. This seemed to Mr. Sugden to emphasize the plea which he was making for local authorities to deal with the apparently considerable proportion of larger cold blast cupolas still fitted with dry type arresters, or with no arresters at all.

Mr. Sugden agreed that the three main sources of pollution which Mr. Burrows had said affected the Eston Urban District, were in fact the three major problems of all iron and steel producing areas. It did seem that it was now known how to prevent the worst of the emissions from ore sintering plants and open hearth furnaces with their latest acquisition of oxygen lancing, and it was now a question of getting these applied. Coke oven plants still seemed to present an almost intractable problem, and he felt that everything possible should be done at every level to press for more investigation and research until a suitable solution was found.

Replying to County Alderman Gavin, Mr. Sugden felt that he had made a very important point in stressing that equipment provided for grit and dust removal should be maintained in a good operative condition, and that there should be adequate and efficient means of disposing of the material collected without causing nuisance. There did not seem to be much point in installing expensive equipment to prevent the emission of smoke from chimney tops if the material after collection was to be placed in piles and allowed to blow about at ground level.

Mr. Sugden was particularly grateful to Mr. Ireland for his comments. It was most refreshing to hear him say that the local authorities were the guardians of the air in their districts, whether works were registered or not. The fact that he could say that, demonstrated in no uncertain way the intention of the Alkali Inspectorate to co-operate with the local authorities. Mr. Sugden hoped that the practical suggestions which he had made in his paper for improving the liaison between the local Alkali Inspector and the local councillors, would receive careful consideration in Whitehall.

He thanked Mr. Ireland for giving some figures to show the relative numbers of plants coming under local authority and Alkali Inspectorate control. This should have done much to dispel the idea which had been inferred several times during the conference that the local authority's interests were confined to the field of domestic smoke control. If this belief was allowed to gain credence there was a danger that some local authorities might sit back, vainly waiting for someone else to deal with the problems which they themselves ought to have been tackling.

Mr. Sugden accepted Mr. Ireland's correction about the application of Section 10 to the height of chimneys of premises to be registered under the Alkali Works Act. If the local authority had to fix the height of chimneys which, once the plant began to operate, would come under the control of the Alkali Inspectorate, it was a further pointer to the need for the closest co-operation between the Alkali Inspector and the Public Health Inspector.

Mr. Short, in reply, first thanked Mr. Emerson for his comments on the paper, and pointed out that the chimney height required was above the surrounding ground level, no matter where the boiler plant might be, on the roof, at ground level or in a basement boilerhouse. It was the dispersion of the plume that was the important thing.

He agreed with Dr. Jackson that there would be a considerable problem if it became necessary to monitor say 10,000 plants. N.I.F.E.S. had several sets of dust sampling equipment and these were in constant use at firms who were anxious to ensure that they were not causing a nuisance to their neighbours. In fact there were several instruments now on the market which either indicated or recorded the concentration of dust in gases, but these were in most cases expensive, and also many only measured a side effect of the dust rather than actual weight per cubic foot of gases.

It was true that, as Mr. Hunter had said, the venturi scrubber could be designed for quite low draught losses, providing a lower efficiency was acceptable.

Many speakers had re-inforced the plea in the authors' paper for good operation and regular maintenance of dust collecting equipment. Only too often complaints were received of dust emission from plants that had been fitted with excellent arrestors and investigation showed that regular cleaning or maintenance would have prevented any trouble at all. The authors would like to close their replies to the various people who had contributed to the discussion by stressing this point once again. Good equipment must be looked after properly if its performance is to be maintained.

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SCARBOROUGH CONFERENCE

8th–11th October, 1963

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List corrected to 26th September; for additions and alterations inquire at the Conference Office, Exhibition Hall

National Society for Clean Air

Scarborough Conference, 1963

LIST OF MEMBERS AND DELEGATES ATTENDING

A

Abernethy, W. M., *Midland Counties Coke Distributors' Association*
Abrams, Cllr. A. B., *Bristol*
Adam, Bailie William, *Dumbarton*
Adams, Dr. D. P., (MOH), *Chesterfield R.D.C.*
Adams, G. S., (PHI & Clean Air Insp.), *Paddington*
Adcock, C. E., (CPHI), *Ilkeston*
Addy, F. B., (CPHI), *Blackburn*
Alexander, G. W., (PHI), *Gloucester*
Alford, Cllr. J. E. R., *Llanelly R.D.C.*
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CLEAN AIR CONFERENCE and EXHIBITION

Handbook Programme and Exhibition Catalogue

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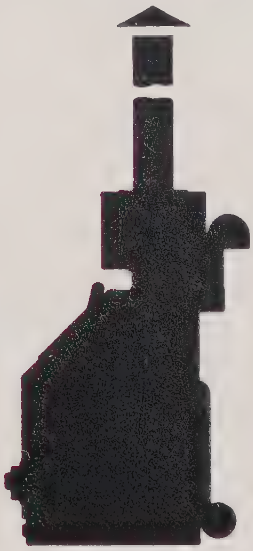

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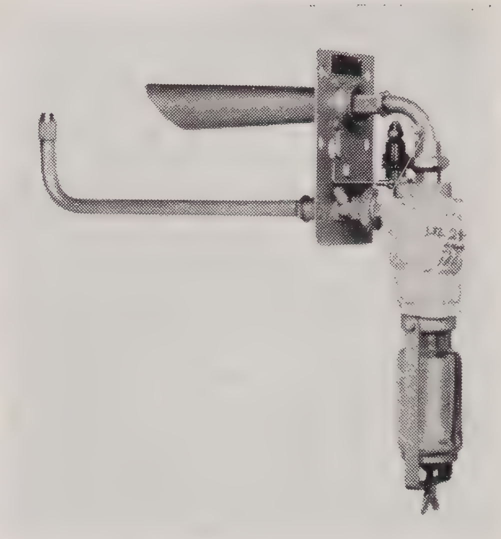

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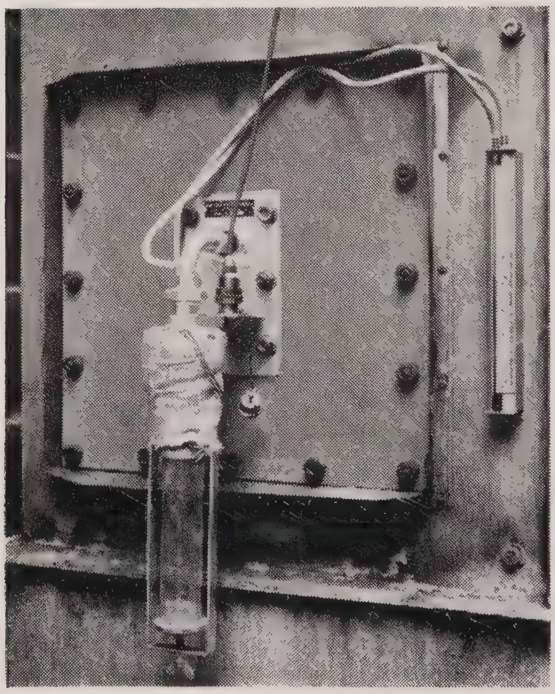

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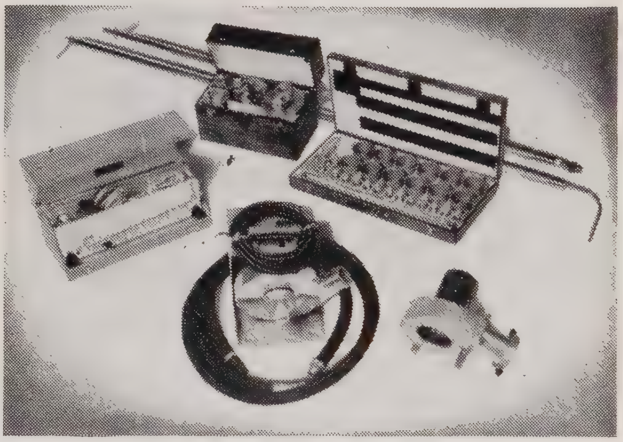

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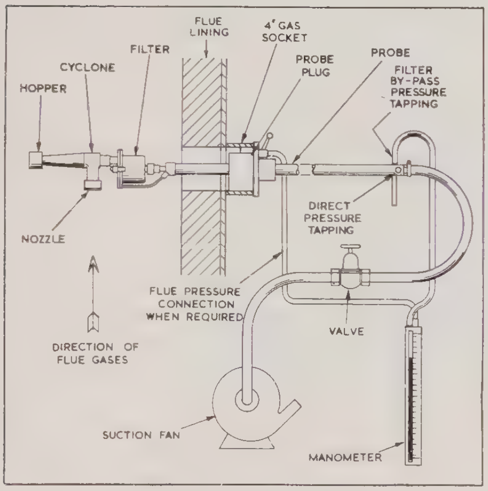

LAYOUT OF APPARATUS

PRINCIPLES OF OPERATION

Samples of the flue gas are drawn into a sampling nozzle attached directly to the inlet of a small cyclone which is inserted in the gas stream at the end of the probe. Particles of grit and dust are centrifuged into a hopper. Gases are drawn through the probe by a suction fan. When operated at sampling rates above 5 cu. ft./min. at N.T.P., the unit collects substantially all dust and grit particles above 5 to 10 microns. For the collection of smoke particles below this size, the cyclone is backed with a glass wool filter.

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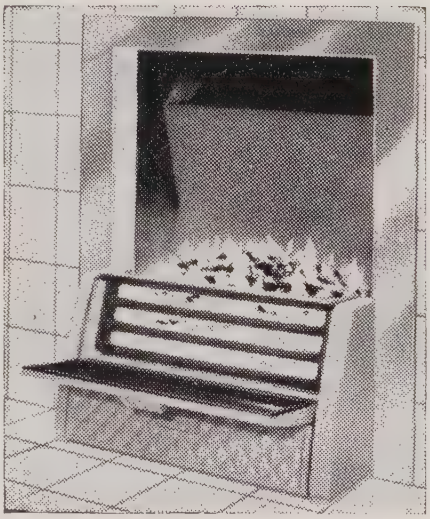

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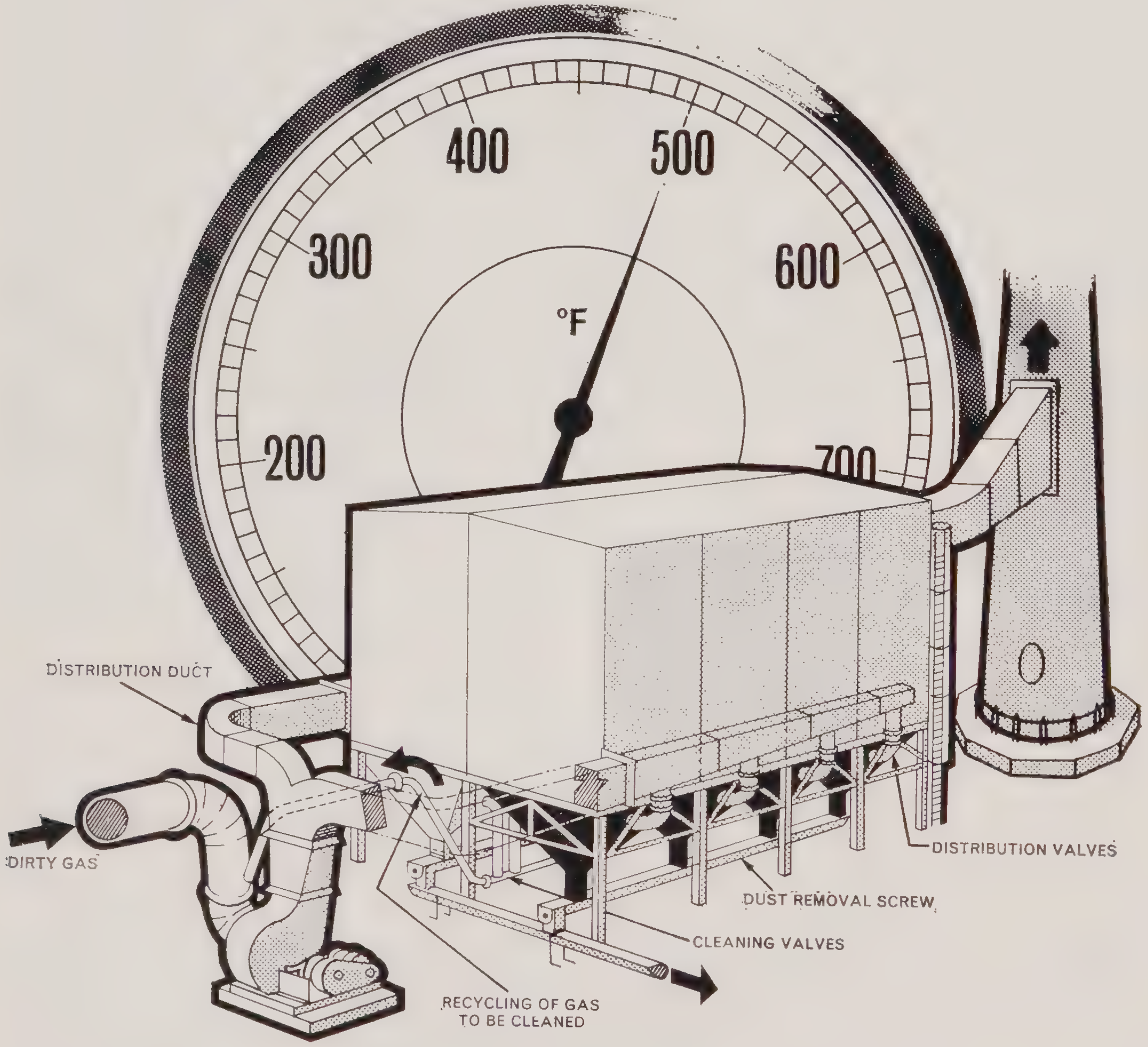

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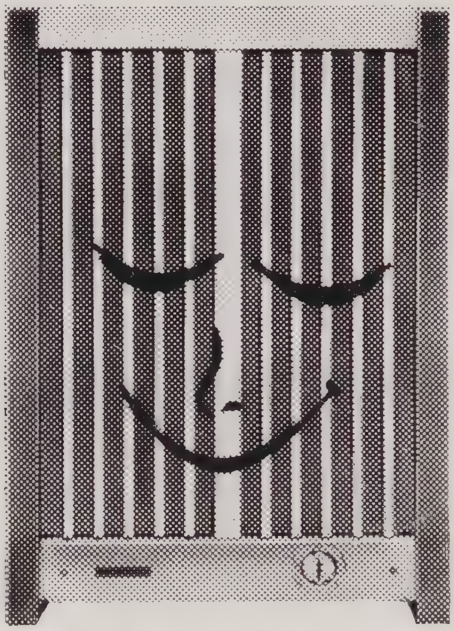

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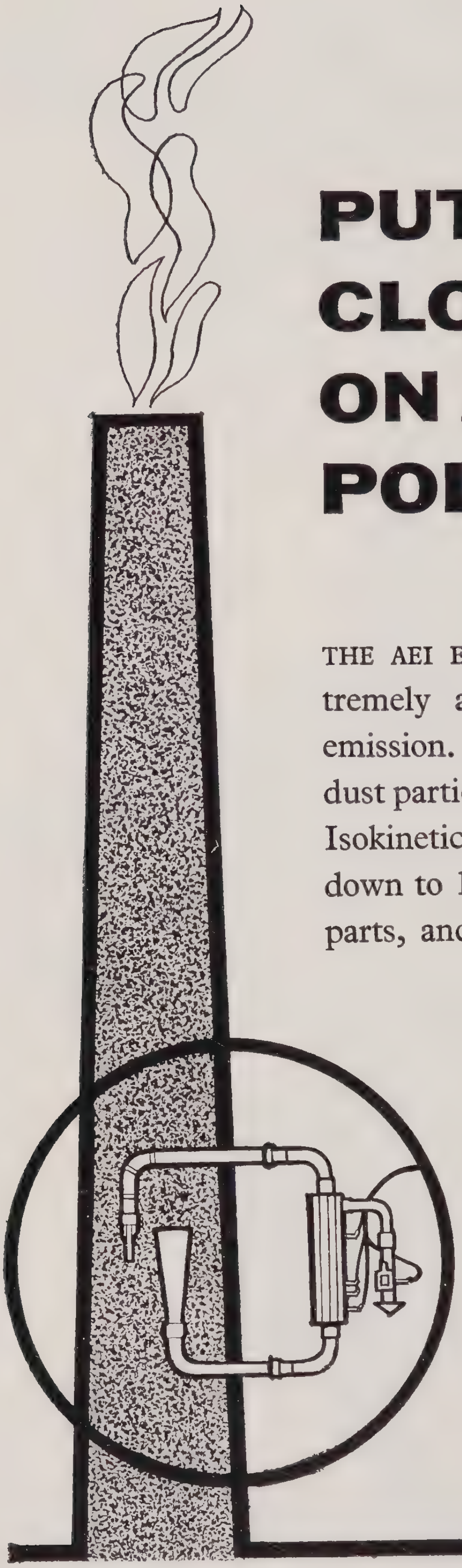

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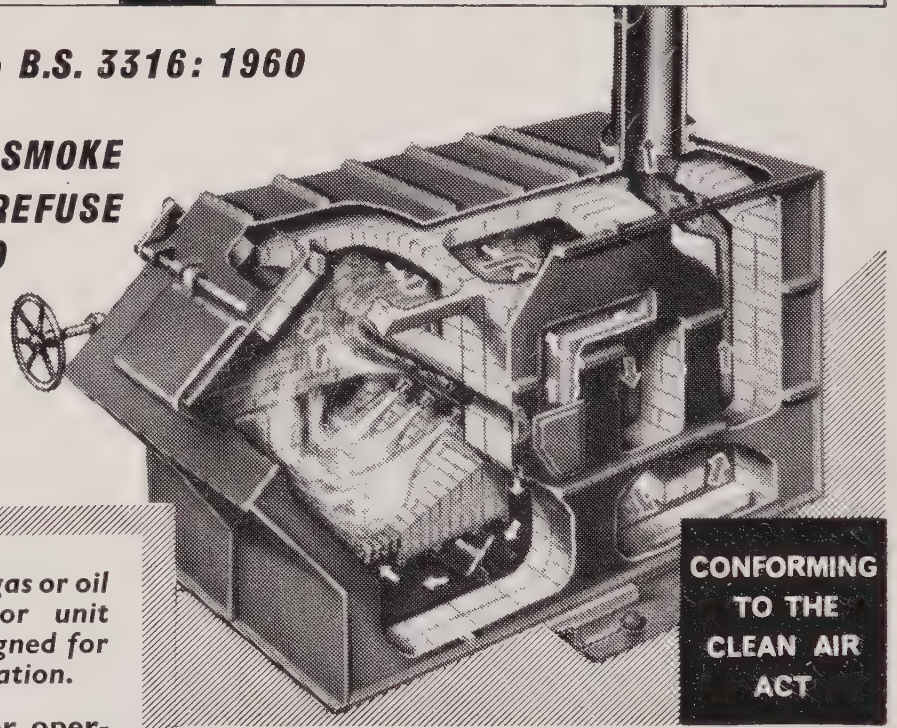

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30th Annual Conference and Exhibition

Scarborough 1963

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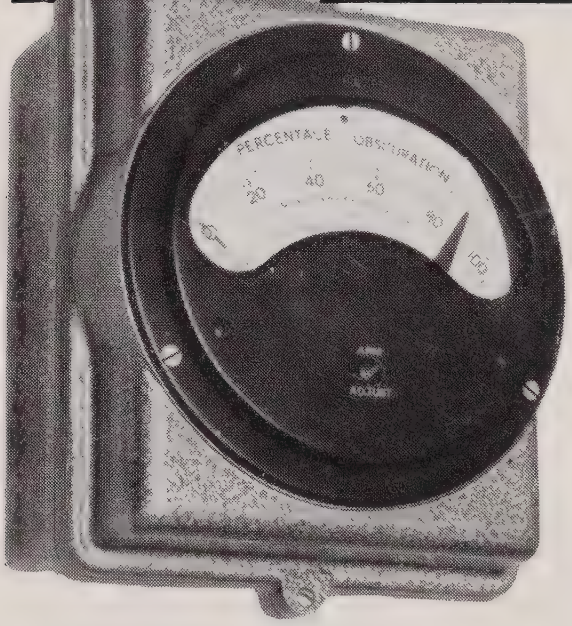

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A Welcome from the Mayor

I am very pleased to have this opportunity of sending a message of welcome to the delegates who will be attending the Conference of the National Society for Clean Air in Scarborough in October.

During the last 10 years Scarborough has built up a reputation as one of the leading Conference Centres in this country and we are very proud of this reputation. The Spa, where the business sessions of your Conference and the Exhibition are to be held, was purchased by the Corporation in 1957 and since then, a scheme has been in operation for the gradual improvement of the amenities for the benefit of Conference delegates. The latest part of the scheme which has just been completed is the complete re-seating and re-decorating of the Spa Grand Hall and I hope you will find this to your liking.

I hope you will have a most successful Conference, that you will enjoy your stay in Scarborough and that we may see the Conference back again in the town very soon.

The Mayoress joins me in sending sincere good wishes to you all and we look forward to meeting many of you at the Conference.

The Mayor's Parlour,
Town Hall,
Scarborough.

(Signed)
WM. H. SMITH
Mayor

Notes on the Conference

IN the breadth of interest that will be found in the addresses to be made and the written papers to be presented, it is believed that this is one of the fullest and most complete conferences the Society has organized. We have a Minister to give the official view, a President to speak as an authority on fuel, two thoughtful contributions on domestic smoke control, one on health, one on road vehicles, a well balanced pair of papers on the general industrial problem and another pair on grit and dust control; and an important group of five papers under the heading "Research and Development", which in their different ways will show new means for progress to clean air that are becoming available. Then there will be an international film show and, for some, visits to industrial works on Tees-side. There will be either a civic reception or a civic variety show for all delegates and their ladies, and tours being arranged especially for the latter. Then there is the Society's Exhibition—which will be the largest and most comprehensive yet. We are particularly pleased that research and development will be featured to a greater extent than before and are confident that the Exhibition will once again be a marked success.

* * *

We regret that the two works visits, about which delegates have previously been sent information, should have to be limited in numbers, which may mean a few disappointments. Most delegates will however have the opportunity of seeing the interesting collection of films that are to be shown on the same afternoon as the visits. We hope that the films are appreciated and shall be pleased, after the Conference, to hear the views and comments of delegates. Then of course, as a reminder, there are the pleasure visits and tours being arranged for delegates' ladies. We are of course obliged to distinguish between delegates' ladies and lady delegates.

The Rt. Hon. Lord Hastings
Joint Parliamentary Secretary, Ministry of Housing and Local Government and Welsh Affairs

* * *

We reproduce opposite a photograph of Alderman William H. Smith, the Mayor of Scarborough, together with the message he has kindly sent to all delegates. Alderman Smith is a retired schoolteacher and was Headmaster of the Friarage County Modern Boys' School until 1961. He is a Scarborian by birth and has played an active part in both his professional organization, the N.U.T., and in local and constituency Labour Parties. Bill Smith, we are told, is a keen fisherman, though at present mayoral duties are impeding this pursuit. His chief interests outside politics are history (especially local) and French, which he speaks pretty fluently.

The Spa

The Scarborough Story

by

S. H. Fewster, D.P.A.*

WHEN I was over in Holland a year or two ago on business connected with our Dutch Festival, a Dutch friend of mine was proudly showing me the huge dykes which surround their coastline to keep the sea out of the low lying countryside.

"Aren't you lucky", he said, "that you don't have this sort of thing to contend with." I agreed enthusiastically because one cannot fail to be enthusiastic about the fantastic dyke construction with which Holland has reclaimed thousands of square miles from the sea.

But when the following year I had the pleasure of entertaining him in Scarborough, I was able with equal pride to show him something of the work which *we* have to do all the time to protect our coastline from the sea.

Seven or eight hundred years ago a monkish historian, describing Scarborough's newly built Castle, wrote of the vast area of 60-70 acres which the curtain wall protected from attack by land. That area is now reduced to about 11 acres—the rest is spread over the sea bed. More recently, the clay hillock at Scalby Mills which used to be called "Monkey Island" was big enough on top, when I was a boy, for us to play cricket. It was finally flattened last year as part of the new development, but when the bulldozers got to work on it, it was only about 5 yards across at the top.

---

*Publicity Manager and Press Officer, Borough of Scarborough.

The building of Scarborough's sea walls, which now stretch for more than 4 miles along the whole length of the two bays, began almost as soon as Scarborough became a town, nearly 1000 years ago. A Royal Charter of Henry III in 1252 gave the townspeople the right to levy a toll of 6d. on every merchant ship and 4d. on every fisherman's ship arriving in the port. The money was to pay for the making of a "new port with timber and stone towards the sea"—the begining of the massive stone piers which now surround the harbour.

Progress over the centuries, however, was slow and it was not until Scarborough began its rapid development following the railway link with York in 1845, that our engineers set themselves to the problem of coast protection.

The first major work was of course the Marine Drive which ran round the foot of the Castle Hill, not only forming a road to link the North and South Bays, but primarily acting as a barrier against the vicious seas which had already washed away the Clarence Gardens and threatened to undermine the cliffs on which stood the imposing hotels of Queen's Parade. So powerful are the waves at this point that, in time, there is no doubt that they would have broken through the narrow peninsula and made the Castle Hill into an offshore island.

The work of building the Marine Drive, which started with great optimism in 1895, was expected to be completed in three years. Unhappily the lack of experience and the puny tools of that day proved no match for the inexorable force of the North Sea gales. The Marine Drive was finished thirteen years later, having broken not only three contractors but also

The "Spaw" Pump Room at the end of the eighteenth century the hearts of the Council and the ratepayers in the process.

But this was a start and within the next twenty years the great wall was extended southwards to the Bathing Pool and northwards towards Scalby Mills. As the town extends, however, so must the wall, and in the last five years Scarborough has spent over £200,000 on extensions to its sea wall at both ends. Building techniques have improved too and Scarborough's engineers have cause to be proud of the fact that although the great storm of 1953 damaged the wall in a few places, it was not completely breached.

The latest extension was completed only six months ago. It was in fact the completion of the North Bay Promenade to surround Scalby Mills. This was a major scheme of reclamation because the wall has been made to curve out into the sea and the area behind it, including the 70 foot high "Monkey Island" has been levelled to form an area of new land some 4½ acres in extent.

With land on the sea front at such a premium, this is a major achievement and within the next year this area will be developed as the latest of Scarborough's amenities. The plans include a new licensed hotel complete with open air Beer Garden, a café restaurant, an amusement park, a children's paddling pool, and a car park for more than 200 cars. The scheme also includes a new 24 foot access road from the main road and, situated as it is at the end of the Miniature Railway in a sun trap sheltered by the surrounding cliffs, there is no doubt that it is going to be one of Scarborough's brightest spots for the whole family. And although it will have cost Scarborough more than £250,000 it is money well spent.

Scalby Mills, about 1879

The Last Time at Scarborough

It is nine years since the Society met at Scarborough, but a great deal has happened since 1954. It was the largest conference the Society had held, with an attendance of about 500—half the number of those who will be at Scarborough this year.

It was held during the time of the Beaver Committee, and one of the features of the conference was an address by Sir Hugh Beaver—the first time he had attended a gathering of the National Smoke Abatement Society (as it then was). Sir Hugh explained that he was in a difficulty, for he could not anticipate the report of his committee, which was just then being completed. He did, however, say some very pertinent things and his address showed that the inquiry that the committee had conducted had at least thoroughly convinced its chairman of the urgent need for clean air.

The President that year was Sir Ernest Smith, and in his address he had many telling facts to give, and points to make, about the fuel situation, as it then was. He mentioned that the Society, in a now-forgotten pamphlet in 1942 had urged the creation of a Ministry of Fuel. In other ways too he paid tribute to the work and influence of the Society. His concluding paragraph included a quotation from Dr. P. L. Jacks, Principal and Professor of Philosophy at Manchester College, Oxford. It is a brilliant little prayer, and as it has (at least) as much point as ever it had, it should be repeated:

> "From all destroyers of natural beauty in this parish and everywhere; from all polluters of earth, air and water; from all makers of visible abominations; from jerry-builders, disfiguring advertisers, road-hogs and spreaders of litter; from the villainies of the rapacious and the incompetence of the stupid; from the carelessness of individuals and the somnolence of local authorities; from all foul smells, noises and sights—Good Lord, deliver us!"

The other special address was a Des Voeux Memorial Lecture, given by Sir Edward Salisbury, Secretary of the Royal Society and Director of the Royal Botanic Gardens, Kew. It was an outstanding example of what was sought for in these lectures—combining literary quality with a broad picture of the theme, informative and interesting to specialist and layman alike.

The conference was short, opening on the Wednesday morning and concluding on Friday morning. With the addresses already mentioned there was room only for two ordinary sessions—one on the smoke problem of the railways, and the other, with two papers, on developments in the industrial uses of gas and electricity. It must be remembered that at that time, between the 1952 smog and the 1954 report (not to mention the 1956 Act) the movement was in a sense marking time; waiting, so to speak, for the Beaver balloon to go up. One resolution was moved, on behalf of the Executive Council, and was unanimously carried. It urged the Government "to promote early legislation granting permissive powers to local authorities to establish smokeless zones, thereby obviating the necessity for the promotion of Private Bills."

In less than two years this was done.

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formerly the

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South Wales and Monmouthshire: Alderman Dr. C. A. Bence, J. A. Church.

Headquarters Staff:

Director, Secretary and Editor: Arnold Marsh, O.B.E.

Assistant Secretary: Alan A. Mister.

Exhibitions and Advertisement Officer: Roy J. Sharp.

Information Officer and Librarian: Mrs. V. Finlay.

Accountant: Mrs. D. M. Wolfe.

Secretarial Assistants: Mrs. M. H. Mellins, Miss B. Bull, Miss A. Roberts, Miss J. Negus, Miss G. Kosky.

For New Delegates

ABOUT THE SOCIETY

Those who are attending the Conference for the first time may wish to know more about the National Society for Clean Air. As we celebrated our Diamond Jubilee in 1959 with a special International Conference it will be seen that the Society has quite a long history. Starting in a very small way with but a handful of private individuals, the Coal Smoke Abatement Society was formed in 1899. It did valuable pioneering work and accomplished the first necessary stage of making it understood that clean air was not the impractical fad of a few cranks. It did much behind the scenes when the Newton Committee was set up, and co-operated with a provincial association that had been formed in 1909, the Smoke Abatement League of Great Britain. In 1929 the two bodies joined together to form the National Smoke Abatement Society.

This name was retained until 1958, when it was changed to the present one, and at the same time, to put its membership and finances on a recognized business footing, it became a Company Limited by Guarantee and not having a share capital. It is licensed by the Board of Trade to omit the word "Limited" from its name and is registered as a Charity with the Charities Commission. It is similarly recognized by the Board of Inland Revenue for income tax purposes.

The Society is a voluntary organization essentially subsisting on the subscriptions of its members, and it does not receive any official grant or subsidy. Its members include individuals, local authorities and firms, associations and other corporate bodies. Although local authorities—over 500—constitute the largest class of membership the corporate members make the largest class of subscriptions. The Society is governed by an Executive Council consisting partly of elected representatives of members on a divisional basis, and partly of the appointed representatives of national organizations in membership. The Divisions are Scotland, North-West, North-East, Yorkshire, West Midlands, East Midlands, South-East, South Wales and Monmouthshire, South-West and Northern Ireland. There are Divisional Councils of members, with their own committees and honorary officers, in each of the Divisions except the South-West.

The Society's objects are, in brief, to promote clean air by education, publicity and similar means, to encourage the adoption of means for clean air, and generally to help to create a public opinion in favour of these objects. Its main activities are the publication of a journal, Year Book and other literature, the holding of conferences and meetings, providing educational and publicity material, information and other services, and co-operating with others.

The Society and its parent bodies have many achievements to their credit, from pioneering the training of boilerhouse firemen and the regular measurement of air pollution to the conception and advocacy of smokeless zones and prior approval.

Today, with the Clean Air Act in force, the opportunities for useful activity by the Society are greater than ever before, and are in fact both needed and demanded more than ever before. But much remains undone because its income is only a tithe of what could be used to advantage. New members, and more new members, are needed—and if you, as a delegate to this conference, can help us to secure them you will be doing a very good turn to the cause of clean air.

Conference Information

Meeting Place

Details of the various meeting places are given at the head of the conference programme on page 32.

Registration

A Registration Card will be enclosed with this Handbook, and you are requested to complete this and hand it in at the Society's Information Desk, at the first session attended.

Discussions

Those wishing to speak in the discussions should complete and hand in a printed Discussion Card which may be obtained from the Information Desk or Steward in the hall. All speakers are requested to: (*a*) condense their remarks as much as possible, and (*b*) confine them to the specific questions raised in the papers being discussed. The time allowed for contributions will normally be limited to three minutes. Those who take part in the discussions and wish to have their remarks recorded are asked to send a condensed copy of their remarks, in reported speech, to the Director not later than October 18.

Resolutions

The following conditions for the submission of resolution are stipulated by the Executive Council:

(*a*) Any resolution it is desired to submit must be relevant to matters under discussion at the conference.

(*b*) No resolution may be moved except by prior approval of the Resolutions Committee.

(*c*) A copy of the proposed resolution must be received by the Director not later than 10.30 a.m. on Wednesday, October 9, or preferably by post (at the Society's offices) on or before October 4.

(*d*) Resolutions will be moved at the end of the Friday morning session only.

List of Delegates

A printed list of delegates will be available in the Conference Office in the Spa Ballroom.

Proceedings

All the Papers, Addresses, discussions and any resolutions adopted will be published in volume form as the *Proceedings* of the Conference. A copy will be forwarded free of charge to all registered delegates and extra copies will be available at about 25s. each.

Bookstall

The Society's, H.M.S.O., and other publications will be displayed on a bookstand in the Ballroom. They will also be displayed in, and may be purchased from, the Conference Office.

Conference Office

The Society's Conference Office will be in the Spa Ballroom, where members of the Staff will be pleased to answer inquiries. The accountant will be at the office for the receipt of fees and other payments. There will also be an Information Desk in the foyer of the Grand Hall.

The Exhibition

The National Clean Air, Fuel Efficiency and Domestic Heating Exhibition—the sixth to be organized by the Society in conjunction with its annual conference—will be in the Green Lounge, the Green Lounge Café, the Band Enclosure, and the Ballroom of the Spa.

All delegates should make a point of inspecting the exhibition. For hours of opening see page 37. Particular attention is drawn to the Society's own stand in the Ballroom, where some of the latest publicity aids available to local authorities and others will be on display. All exhibition inquiries, including information about the Seventh Exhibition, at Harrogate in October 1964, should be addressed to the Exhibition Organizer, Roy J. Sharp.

Visits and Tours

Details of works visits and tours for delegates' ladies have been sent to delegates. Any further information about the arrangements will be announced or displayed at the conference and will be available at the Conference Office. Inquiries should be made to the Assistant Secretary, Alan A. Mister.

Bank Facilities

Full banking facilities will be available to all attending the Conference or Exhibition from the District Bank Ltd., at Stand A.8 in the Green Lounge.

Rail Travel

There will be a British Railways Inquiry Bureau in the Conference Office in the Spa Ballroom, where information about rail travel, seat reservations, etc., may be made. Delegates should have received a B.R. Conference Voucher to enable them to obtain tickets at a special concessionary rate.

Refreshment Facilities

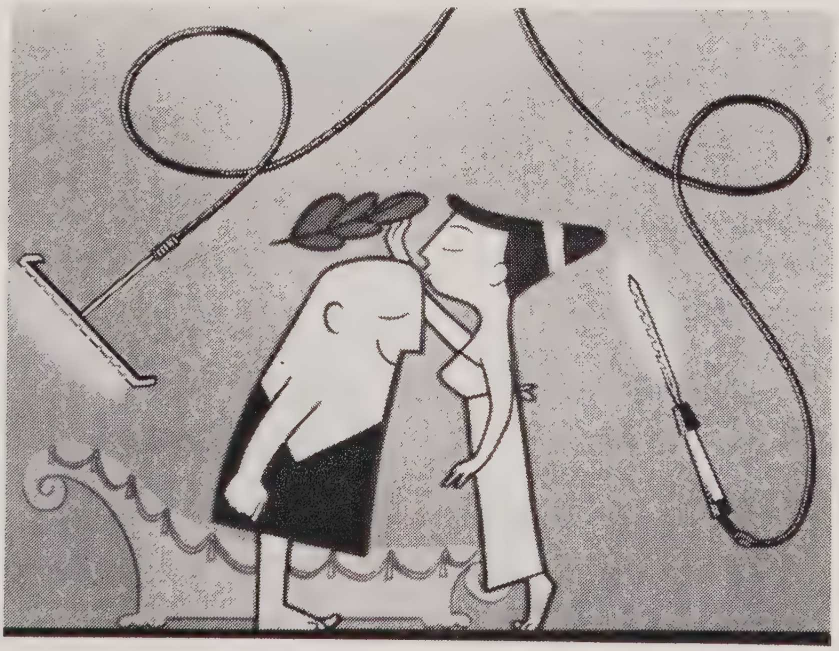
A refreshment bar and Tea Garden will be provided in the Spa Ballroom for delegates and visitors to the exhibition. A licensed bar will also be available on the mezzanine floor of the Ballroom.

Photography

The official photographer is Mr. Paul Dong, member of the Institute of Journalists, who will be solely responsible for all photographs of the exhibition, conference and other events. He will have an office and darkroom in the Spa Ballroom and will provide a 24-hour service. He and his assistant will wear badges, and delegates and visitors are advised not to give orders for photographs to any unauthorized photographer or agent.

General Inquiries

The Society's staff at the Conference Office and Information Desk will be pleased to assist with any inquiries on matters not mentioned above.



From the cartoon film "All Lit Up" (see Film Show Programme)

Platform Who's Who

Allen, B. D., D.P.A., M.R.S.H., M.A.P.H.I. Chief Public Health Inspector, City of Coventry; Executive Committee Member, Midlands Joint Advisory Clean Air Council; Member, Technical Advisory Committee, Warwickshire Clean Air Council; Executive Committee Member, West Midlands Division, N.S.C.A.

Barrett, C. F., M.Sc. Warren Spring Laboratory, Stevenage.

Bellingham, Eric, O.B.E., LL.B., L.M.T.P.I. Solicitor; One time Town Clerk of Stockton, thereafter with Hemel Hempstead New Town; Subsequently Director - General, Coal Utilization Council; Later with a domestic appliance manufacturers and now a consultant with the National Coal Board.

Britten, A. N., B.Sc., A.M.I.Mech.E. Technical Department, Imperial Chemical Industries Ltd. (Alkali Division).

Burn, J. L., M.D., D.Hy., D.P.H. Medical Officer of Health, Salford; Chairman of Executive Council, N.S.C.A.

Burnett, J. S. G., M.D., D.P.H. Medical Officer of Health, Preston; Chairman, Technical Committee, N.S.C.A.; Past-Chairman, Executive Council, N.S.C.A.

Calvert, J. G., M.A.P.H.I. Public Health Inspector, Rural District of Stratford-on-Avon; Member, Technical Advisory Committee, Warwickshire Clean Air Council.

Catterall, Dr. Mary, M.B., B.S., D.M.R.T. Research Fellow for Respiratory Diseases, and Senior Registrar in charge of Respiratory Function Laboratory, The General Infirmary, Leeds.

Clarke, A. J. Principal Assistant Engineer, Planning Department, Central Electricity Generating Board.

Clegg, L., M.B.E., C.G.I.A., M.I.Chem.E., F.Inst.F. Chief Engineer, National Industrial Fuel Efficiency Service.

Cohen, Stanley, E., C.C., F.R.S.H. Honorary Treasurer; Member of the Clean Air Council; Member of the Court of Common Council, City of London.

Crow, R. K., B.Sc., F.A.P.H.I. Chief Public Health Inspector, Borough of Rugby. Member, Technical Advisory Committee, Warwickshire Clean Air Council.

Emerson, R., M.R.S.H., M.A.P.H.I. Chief Public Health Inspector, West Hartlepool.

Gibbons, Councillor E. B., J.P., M.I.G.E., M.Inst.F. Member, Brierley Hill Urban District Council; Director, Gibbons Brothers Limited; Vice-President, N.S.C.A.

Goodfellow, James, F.R.S.H., M.A.P.H.I. Chief Public Health Inspector, Leeds; Joint Deputy Chairman of Executive Council, N.S.C.A.; Hon. Secretary, Yorkshire Division, N.S.C.A.

Griffith, Miriam V., B.Sc., F.Inst.P. Head of Heating Research, Electrical Research Association.

Hacking, A., R. O.B.E., M.Sc., F.I.M., F.I.Ceram. Director of Research, Richard Thomas and Baldwins Ltd. Member of the Clean Air Council and Executive Council, N.S.C.A.

Hastings, The Rt. Hon. Lord. Parliamentary Secretary, Ministry of Housing and Local Government.

Johnson, Charles, A.M.I.C.E., M.I.Mech.E. Coal Officer, The Gas Council.

Lawther, Dr. Patrick J., M.R.C.P. Director, Medical Research Council, Air Pollution Research Unit, and Consultant in Environmental Medicine (St. Bartholomew's Hospital).

Lovell Burgess, Miss M. A. Lectures Officer, The Gas Council; Hon. Secretary, Public Relations Section, Institute of Journalists; Member, Royal Institute of Public Health and Hygiene.

Parker, Dr. Albert, C.B.E., D.Sc. President, Former Director, Fuel Research Station, D.S.I.R., Executive Vice-President, Royal Society of Health; Hon. Secretary, British National Committee, World Power Conference.

Reed, L. E., Ph.D., A.M.I.Mech.E. Warren Spring Laboratory, Stevenage.

Short, W., B.Sc., M.Inst.F. Area Engineer, National Industrial Fuel Efficiency Service.

Stone, G. N., B.Sc.(Eng.). Section Head, Planning Department, Central Electricity Generating Board.

Sugden, F. G., D.P.A., M.R.S.H., F.A.P.H.I. Chief Public Health Inspector, County Borough of Middlesbrough.

Smith, Alderman W. H., J.P. Mayor of Scarborough. (*See page 20.*)

Taylor, A. Alan, Ph.D., M.Sc., F.Inst.F. Manager, Sales Promotion (Technical) Branch, National Coal Board.

Turner, T. Henry, M.Sc., M.I.Mech.E., M.I.Loco.Eng., F.I.M. Individual Member; Joint Deputy Chairman, N.S.C.A.

Wallin, S. C. Warren Spring Laboratory, Stevenage.

Willison, Mrs. M. E., Regional Assistant, Solid Smokeless Fuels Federation.

Wilson, Dr. J. Greenwood. Medical Officer of Health, Port and City of London.

Previous Conferences of the Society

1929	Buxton
1930	Leicester
1931	Liverpool
1932	Newcastle-upon-Tyne
1933	Sheffield
1934	Glasgow
1935	Bristol
1936	London (Science Museum)
1937	Leeds
1938	Cardiff
1943	London*
1945	London*
1946	Brighton*
1947	Edinburgh
1948	Cheltenham*
1949	Harrogate*
1950	Margate*
1951	Blackpool
1952	Portsmouth*
1953	Glasgow*
1954	Scarborough*
1955	Bournemouth
1956	Southport*
1957	Hastings*
1958	Llandudno*
1959	London (Diamond Jubilee International)*
1960	Harrogate*
1961	Brighton*
1962	Harrogate*

* *Proceedings still available. For prices and other details see current Clean Air Year Book.*

Programme
of the
Conference

Meeting Places

Conference Sessions: Grand Hall, the Spa
Film Show and Civic Variety Show: The Spa Theatre
Civic Reception: Olympia
Informal Gathering: Grand Hotel

For details of Authors, Speakers, etc., see "Platform Who's Who", page 30

Monday, October 7
Evening

From 8.00 Informal Gathering.

Tuesday, October 8
Morning

10.00 Opening Session.

Chairman: The President, Dr. Albert Parker, C.B.E.

Civic Welcome by the Worshipful the Mayor of Scarborough, Alderman William H. Smith, J.P.

Address and Opening of the Conference by the Rt. Hon. Lord Hastings, Joint Parliamentary Secretary, Ministry of Housing and Local Government.

The Presidential Address.

Stanley E. Cohen, C.C., Honorary Treasurer, to propose thanks.

Tuesday, October 8—*continued*

11.30 Conclusion of Session. The Principals in the Platform Party will proceed to the Exhibition, which will be formally opened by the Minister.

Afternoon

Chairman: Dr. J. L. Burn

2.30 Domestic Smoke Control.

Smoke Control Areas and their Problems, by Eric Bellingham, O.B.E.

The Importance of Public Relations, by Miss M. A. Lovell Burgess.

Discussion Opener: Mrs. M. E. Willison.

4.30 approx. Close of session.

5.30 Exhibition closes.

Wednesday, October 9

Morning

9.30 Exhibition opens.

Chairman: Dr. P. J. Lawther

10.00 Air Pollution: the Human Problem, by Dr. Mary Catterall.

Pollution from Road Vehicles. Report from the Society's Technical Committee, presented by its Chairman, Dr. J. S. G. Burnett.

Discussion Opener: Dr. J. Greenwood Wilson.

12.30 approx. Lunch adjournment.

Afternoon

Chairman: Councillor Eric Gibbons, J.P.

2.30 Industry and the Clean Air Act.

(1) Progress in a Heavy Chemical Industry, by A. N. Britten.

(2) The Warwickshire Clean Air Council: an Exercise in Co-operation, by B. D. Allen, J. G. Calvert and R. K. Crow.

Discussion Opener: R. A. Hacking, O.B.E.

Wednesday, October 9—*continued*

4.30 approx. Close of session.

5.30 Exhibition closes.

Evening

8.00 Civic Reception and Variety Show (by invitation)

Thursday, October 10

Morning

9.30 Exhibition opens.

Chairman: James Goodfellow

10.00 Research and Development.

An Experimental Chimney, by Dr. L. E. Reed, C. F. Barrett and S. C. Wallin.

Developments in the Coal Industry Related to Clean Air, by Dr. A. Alan Taylor.

The Gas Council's Search for Natural Gas and Underground Gas Storage, by Charles Johnson.

Power Stations and Clean Air, by G. N. Stone and A. J. Clarke.

The Applications and Performance of Off-Peak Electrical Space Heating in Buildings, by Miss M. V. Griffith.

Discussion Opener: The President, Dr. Albert Parker, C.B.E.

12.30 approx. Lunch adjournment.

Afternoon

2.30 Film Session—see page 36 for programme.

4.00 Close of film session.

5.30 Exhibition closes.

Evening

8.00 Film Entertainment (Spa Theatre)—see next page

Friday, October 11

Morning

9.30 Exhibition opens.

Chairman: T. Henry Turner

10.00 Grit and Dust Emissions.

(1) Technical Aspects and Means for Control, by L. Clegg, M.B.E., and W. Short.

(2) Administrative Problems of Control, by F. G. Sugden.

Discussion Opener: R. Emerson.

12.15 Any resolutions; General vote of thanks, etc.

12.30 Close of Conference and Exhibition.

A FILM ENTERTAINMENT

The programme of clean air films on Thursday afternoon, details of which are given on the next page, is part of the conference. The Film Entertainment at 8 p.m. on Thursday evening, also in the Spa Theatre, is simply for pleasure. Seven short films, all of outstanding quality and interest, will be shown. They will transport the audience to winter in the Alps, to the coming of spring in Gilbert White's Selborne, on a journey to the Dales, out to the magnificent scenery of New Zealand, back to some of the loveliest corners of Europe and into the romantic world of old Germany, rich and colourful in Baroque and Rococo delights. And, for comedy, one of the intriguing cartoon films that come from Czechoslovakia. A detailed programme will be available at the show. Admission free, of course, to all delegates, exhibitors and their ladies.

THE FILM SHOW PROGRAMME

The film show on Thursday, October 10, will be held in the Spa Theatre at 2.30 p.m.

The programme is of an international nature and while it cannot attempt to give a complete picture of the world-wide efforts being made to achieve clean air it is a gratifying record of positive achievement and continuing struggle.

All the films are 16 mm. sound prints.

(1) EXPEDITION: CITY FALLOUT

Originally produced for television by W.A.B.C. and shown in New York last year.

Actual scenes of air pollution in the City of New York highlight a discussion. Jan Crockett discusses the tendency towards urbanization in the United States and suggests we may overtax the limited supply of available air. A surgeon discusses effects on the lungs. (*28 minutes*)

(2) SMOKE

A Czechoslovakian Academy of Art presentation kindly made available to the Society by The Hydraulic Research Institute of Prague. Originally produced in 1960.

The commentary describes the beauty of a sunny dawn but we see smoke and fly-ash as it is an industrial area. The polluted air is driven far into the countryside and forests. Droplets of acid cause the stunting of growth and nature dies. The surroundings of industrial settlements are sacrificed to gas and smoke, SO_2 sours and poisons. However, people are not helpless beings, laboratories measure and analyse, the microscope reveals the structure of pollutants and, incidentally, shows the sharp edge of fly-ash. Electrostatic precipitators are claimed to be the most effective filter and shown at work, very expensive but necessary as an unhealthy medium cannot be tolerated in an expanding industry. Other factory separators are shown and the film concludes with an expression of confidence in the establishment of clean air—everywhere. (*11 minutes*)

(3) HOUSEWARMING

A Thomas Potterton colour cartoon depicts man's quest for adequate heating through the ages. (*9 minutes*)

Interval

(4) ALL LIT UP

A Gas Council production in colour showing the advantages of gas poker ignition. A cartoon film with amusing sequences and original calypso music. (*6 minutes*)

(5) SMOG—THE SILENT KILLER

Produced by A.B.C. TV New York and shown in that city last April.

The Society was closely involved in this picture which tells the story of air pollution in London through the eyes of an American producer. Many well-known in the clean air movement explain their efforts to combat smog. The film concludes with an appraisal of progress from Sir Hugh Beaver. (*24 minutes*)

(6) THE FIRST MILE UP

A National Film Board of Canada production completed in 1961.

The film shows preventative measures being taken in Toronto and explains efforts made jointly with U.S. agencies to clean up Windsor, Ontario. The Donora incident is recalled in a flashback and we are reminded of London's notoriety as a "dirty" city. Nobel Prize winner, Dr. Linus Pauling, warns of the ever present threat from nuclear fall-out. (*28 minutes*)

STOP PRESS

A new film on the N.C.B. solid smokeless fuel process at Birch Coppice will also be shown.

SIXTH NATIONAL
CLEAN AIR
FUEL EFFICIENCY AND DOMESTIC HEATING
EXHIBITION

CATALOGUE

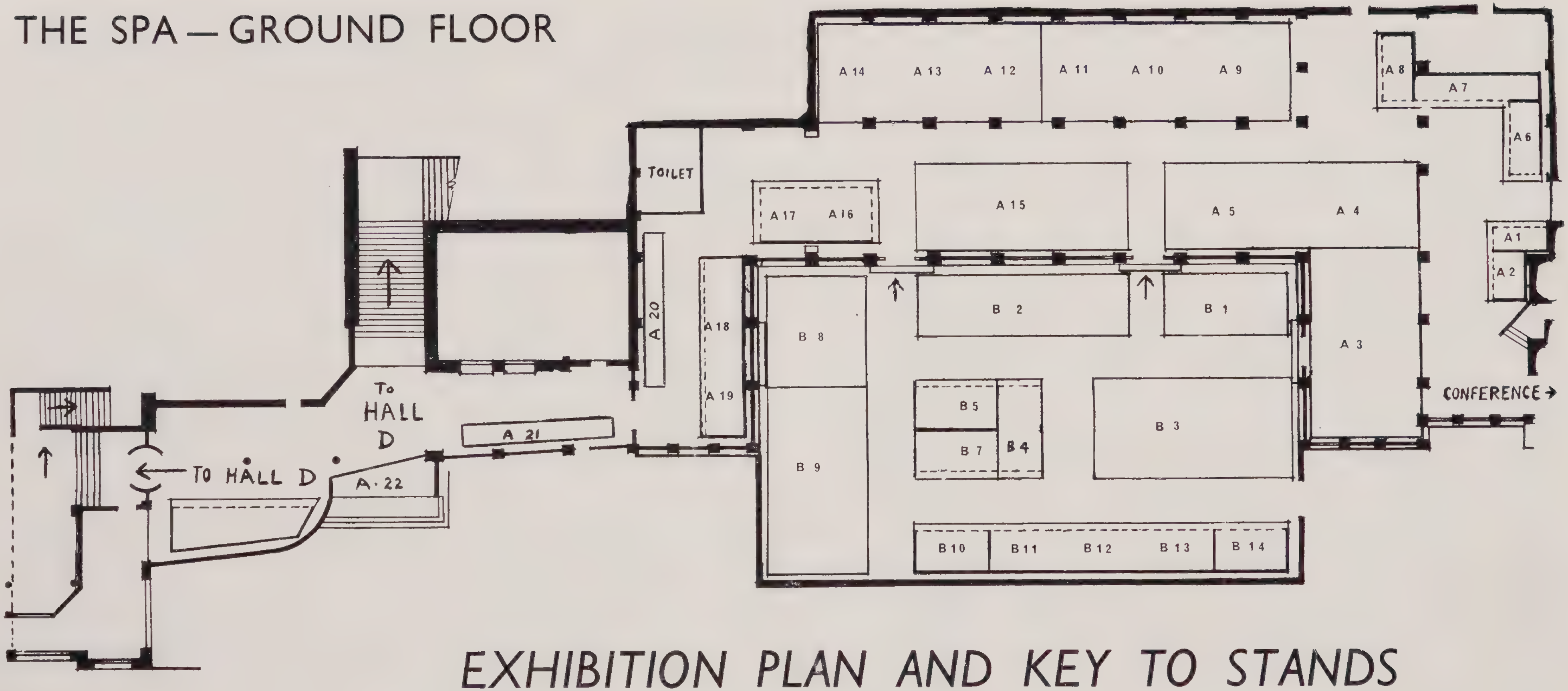
THE SPA,
SCARBOROUGH

8th—11th OCTOBER, 1963

Hours of opening:

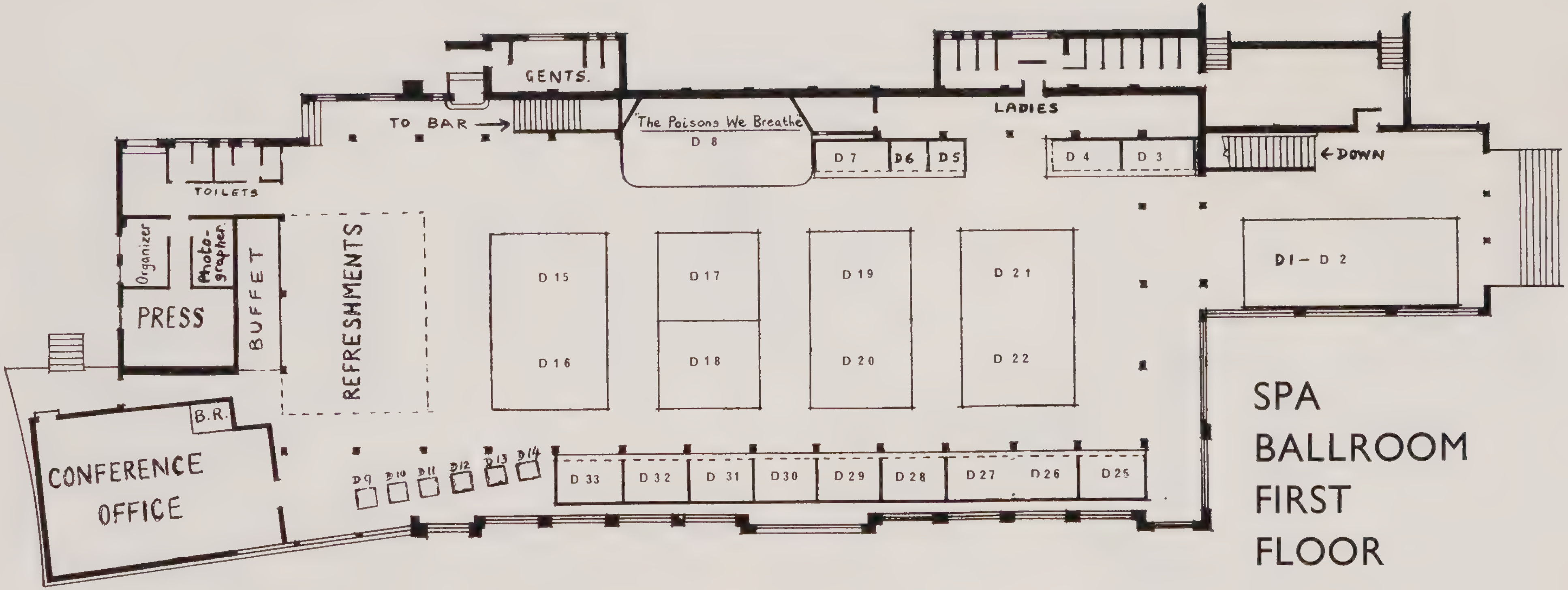
Tuesday, 8th October — 11.30 a.m. to 5.30 p.m.
Trade, Conference Delegates and V.I.P.s.
Wednesday, 9th October — 9.30 a.m. to 5.30 p.m.
Thursday, 10th October — 9.30 a.m. to 5.30 p.m.
Friday, 11th October — 9.30 a.m. to 12.30 p.m.

THE SPA — GROUND FLOOR



EXHIBITION PLAN AND KEY TO STANDS

Stand No.	*Exhibitor*
A.1	Combustion Equipment Ltd.
A.2	H. Pickup Ltd.
A.3	National Carbonising Co.
A.4-5	Coal Utilisation Council.
A.6	Cannon Industries.
A.7	Thomas Potterton Ltd.
A.8	District Bank Ltd.
A.9-11	Electrical Development Association.
A.12-14	Central Electricity Generating Board.
A.15	National Coal Board.
A.16-17	Collectron Ltd.
A.18-19	Tilghman's Ltd.
A.20	Ambuco Ltd.
A.21	John Thompson Ltd.
A.22	British Standards Institution.
B.1	Allied Ironfounders Ltd.
B.2	Solid Smokeless Fuels Federation.
B.3	Coalite & Chemical Products Ltd.
B.4	Smith, Bell & Co. (London) Ltd.
B.5	Davis Estates Ltd.
B.7	Lion Stamping Co. Ltd.
B.8	B.C.U.R.A.
B.9	D.S.I.R.
B.10	Robert Bros. (Audnam) Ltd.
B.11-13	Shell Mex & B.P. Ltd.
B.14	Boston Marine & General Engineering Co. Ltd. (Also outside demonstration).



SPA BALLROOM FIRST FLOOR

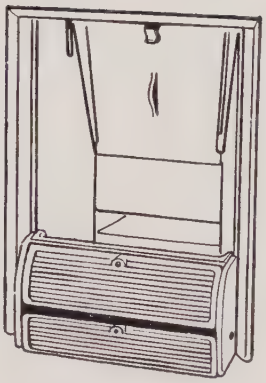
Stand No.	*Exhibitor*
D.1-2	Gas Council.
D.3-4	Robinson & Newbery Ltd.
D.5	Best Products Ltd.
D.6	Saniguard Appliances Ltd.
D.7	Bescol (Electric) Ltd.
D.8	N.S.C.A. "The Poisons We Breathe".
D.9	Pergamon Press Ltd.
D.10	U.S. Department of Health, Education and Welfare.
D.11	*Municipal Journal*.

Stand No.	*Exhibitor*
D.12	Pyramid Press Ltd.
D.13	*Local Government Chronicle*.
D.14	Shaw & Sons Ltd.
D.15-16	Ministry of Housing & Local Government.
D.17	G.E.C. Ltd.
D.18	Radiation Parkray Ltd.
D.19-20	Head Wrightson.
D.21-22	Gas Council (Coke).
D.25	Federated Foundries Ltd.
D.26-27	Revo Electric Co. Ltd.

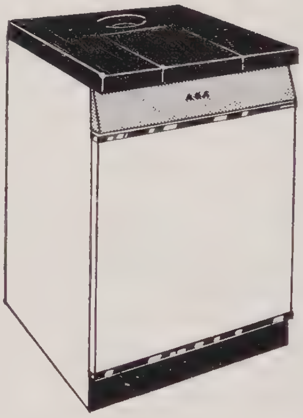
Stand No.	*Exhibitor*
D.28	Riley (IC) Products Ltd.
D.29	Thermodare (Gt. Britain) Ltd.
D.30	Corsectric Ltd.
D.31	Elliott Process Automation Ltd.
D.32	Fleming Instruments Ltd.
D.33	N.S.C.A.
B.R.	British Railways Enquiry Bureau.

No-smoke signal from Big Chief clean air

(him fit heap fine Allied appliance)



Fit um Lowburn Drop Front open fire. Heat 1,750 cubic feet. Heat 1,500 cubic feet with hot water. Get Local Authority Grant. No installation palaver.



Fit um AGA SF 12 boiler. Heat 25 gallons water with 2 radiator. (30 square feet radiation surface.) Him give mighty heat for small, small fuel bill.

SMOKELESS FUEL APPLIANCES BY

ALLIED IRONFOUNDERS LTD AI

Go See um at N.C.B. or C.U.C. Information Centre or at

Stand No. B1 *6th National Clean Air Fuel Efficiency Domestic Heating Exhibition*

EXHIBITORS AND DESCRIPTION OF EXHIBITS

The information given in this list has been supplied by the Exhibitors and no responsibility for any of the statements or descriptions can be accepted by the National Society for Clean Air.

Stand No.

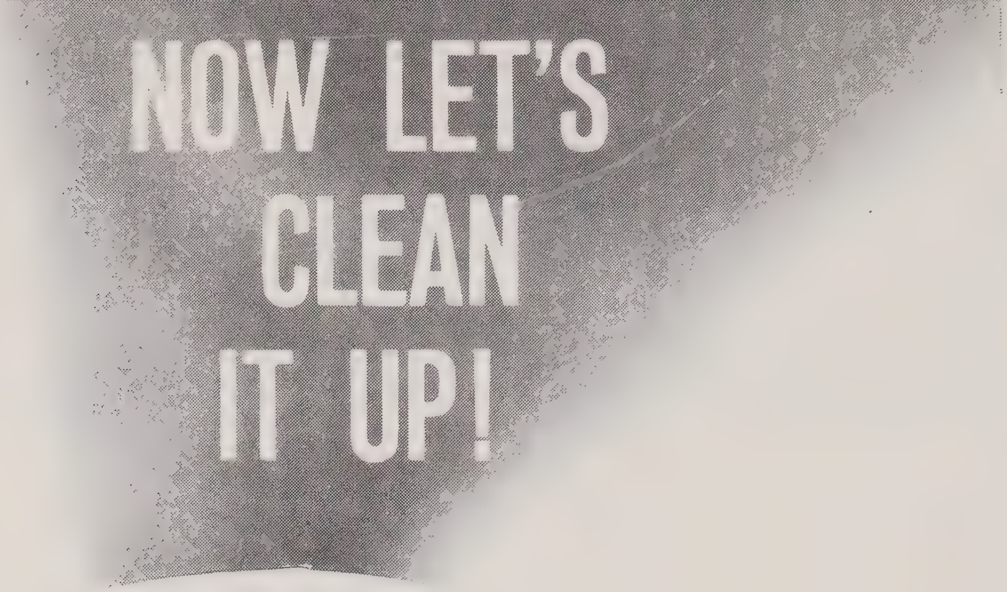
B1 **ALLIED IRONFOUNDERS LTD, 28 Brook Street, London, W.1. (Telephone: GROsvenor 8941).**

DOMESTIC APPLIANCE DIVISION, Cadbury Road, Sunbury-on-Thames, Middlesex. (Telephone: Sunbury 5577)

As major manufacturers of domestic and industrial heating and cooking equipment—boilers, space heaters, radiators and other appliances—and as a company long experienced in the use of all forms of fuel (solid fuel, gas, oil and electricity), Allied Ironfounders are intimately concerned with the technical and educational aspects of Clean Air and Smoke Control. They have designed special displays and other material on these twin themes. These aids are now available for local promotion and examples are featured on the stand.

From the company's continuous research and development in the solid-fuel field, involving valuable collaboration with technicians of the National Coal Board and other authorities, have emerged such outstanding appliances as the "Rayburn Princess" room heaters—offered as non-boiler, standard boiler and high-output boiler models—the "Dale", "Lexham" and "Lowburn Drop Front" fires and the newly restyled "Aga SF" boilers. These are but a few from the comprehensive current range of Allied Ironfounders appliances, designed to use smokeless solid fuels and to comply fully with the terms of the Clean Air Act.

The fires and room heaters, even the back-boiler models, will all fit into an existing 16-inch fireplace opening. A selection is shown at the exhibition, together with the very attractive Allied radiators—water-filled and electric oil-filled—which efficiently complete any modern heating system.



Dust and smoke both mean trouble. They may mean that the requirements of the Clean Air or Alkali Acts are being contravened. They may also mean that a valuable product is going to waste. Ambuco specialize exclusively in dust control. Because of their experience in the application of scrubbers, cyclones and fabric arresters to the chemical, petroleum, and iron and steel industries, Ambuco can provide a system which meets both your technical and commercial requirements. Ambuco installations can be guaranteed to meet the Clean Air and Alkali Acts or other local requirements. If you feel that Ambuco may be able to help 'put dust in its place' in your organisation, we shall be happy to supply all the information you may require.

AMBUCO

PUT DUST IN ITS PLACE!

AMBUCO LIMITED · 49 MOORGATE · LONDON E.C.2

A MEMBER OF THE GOLD FIELDS MINING & INDUSTRIAL GROUP

Stand No.

A20 AMBUCO LIMITED, 49 Moorgate, London, E.C.2. (Telephone: METropolitan 9242).

The Ambuco stand will feature photographic displays and diagrams concerning the industrial fume cleaning and dust recovery activities of the company. There are three basic types of equipment which are concerned, and it will be appreciated that because of their size, they cannot be demonstrated at an exhibition of this nature.

Ambuco Venturi Scrubbers—In this process, the fumes from an industrial process (which may in themselves be chemically harmful or may contain fine particles of solid matter) are caused to pass, at high velocity, through a "double curtain" fine water spray arrangement. Whilst orthodox venturi scrubbers employ a similar technique, the Ambuco process is unique in the employment of this "*double*-scrubbing" arrangement. Examples of typical industrial applications include the following:-

Iron and Steel—Ambuco Venturi Scrubbers have been successfully applied to the exhaust fumes from both Electric Arc Furnaces and L.D. Converters with average efficiencies above 99·6% equivalent to less than ·05 grns of solids in the discharge.

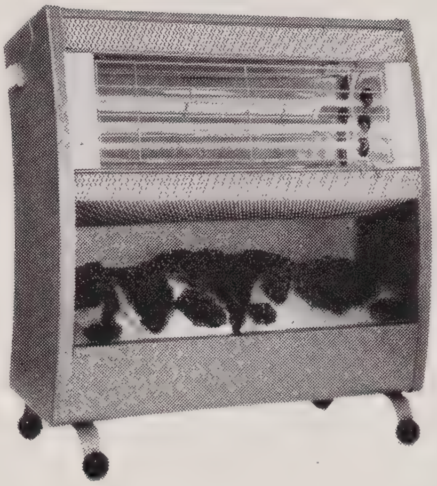
Non-ferrous Metals—In aluminium smelting 99·9% of the sodium chloride present in exhaust fumes is being removed, and entrained solids are being removed to less than 0·03 grains per cubic foot.

Chemical Processes—In various chemical processes, phosphorous pentoxide, phenol formaldehyde and ammonium chloride have all been removed from exhaust fumes to a thoroughly satisfactory level.

Ambuco Cyclone Dust Recovery Units—Widely used in oil refineries and chemical processes, in addition to their use as a fly ash collector, Ambuco cyclones provide an extremely efficient means of recovering fine particles of matter and have many advantages because of their unique design which includes a special "shave-off" port which harnesses the natural turbulence occurring at the top of the cyclone to increase collection efficiency.

Ambuco Fabric Bag Dust Collectors—In this method, dust laden fumes are caused to pass through a series of specially designed and arranged tubular fabric bags. The material from which the bags are made is carefully determined in relation to the dust concerned and the conditions under which it is to be collected.

Information—Ambuco engineers will be attending the conference as delegates and will be pleased to discuss fume control and dust collection problems and to supply descriptive literature.



Parkfield 2¼ KW Infra-Red Coal Effect Fire

Comprising: 3-750 W Silica glass elements, giving 3 heats 750 – 1,500 – 2,250

FINISHED HAMMERED BRONZE

Price **£11 11s. 8d.** (incl. Tax)

The New 1900 Series Convector

1900 – 2 heats: 750-1,500 W
1901 – 4 heats: 625-1,250-1,875-2,500 W
1902 – 2¼ KW incorporating Thermostat

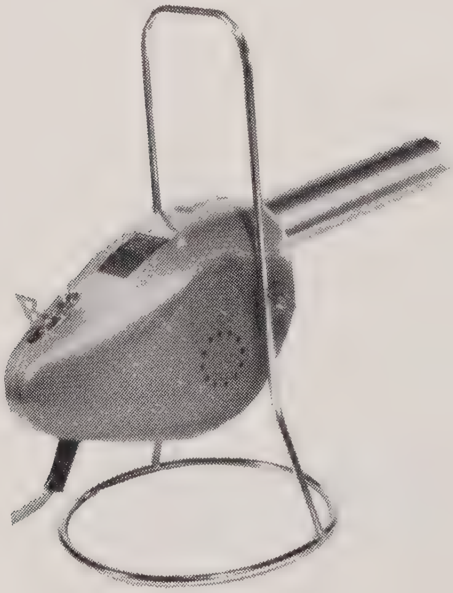
Pleasing and Compact Design. Easily transported – for use in any room or in the hall. Complete Safety – ideal for the nursery. Controlled heat with thermostat model.

BESCOL (ELECTRIC) LTD., Parkfield Road, Birmingham 8

INSIST ON THE **BEST**
MATCHLESS
ELECTRIC FIRELIGHTER

See it on STAND D.5.

£5 . 17 . 9



Ignites every type of fuel without use of wood, paper, etc.

No worries – clean hands

Safety switch

Neon warning light

Approved by E.D.A.

* * *

BEST PRODUCTS LIMITED
FELIXSTOWE • • SUFFOLK

Stand No.

D7 BESCOL (ELECTRIC) LTD. Parkfield Road, Birmingham, 8. (Telephone: EASt 3281).

Visitors to the Bescol (Electric) Ltd. stand will see a pleasing range of Electric Fires and Convector Heaters which include for the first time two new appliances, the "Parkfield" 2¼ kw. Infra Red Coal Effect and the "1900" range of Convector Heaters.

The "Parkfield" infra red fire can be switched to give ¾ kw., 1½ kw., 2¼ kw. output, is contemporary in design and offers that little something different in shape. For the person who desires the inset hearth, the 16 in. "Warrior" 2 kw. has much to commend itself, while in the lower price range, the "Harmony", which incorporates a glass fibre coal effect, built-in sides and handle for easy carrying, can be obtained in a finish of either hammered bronze or hammered pewter. All these fires are fitted with highly polished chromium plated reflectors and guards and are complete with 6 ft. 3-core flex.

The new "1900" range of convector heaters implements the ever popular Bescol Contemporary Range, at the same time giving a greater output. It will be seen that Convector Heaters by Bescol are of pleasing design, are very compact and portable in use for any room or as background heating in the hall, while the thermostat model gives controlled heating at whatever temperature is desired.

Providing warmth for children at an economical cost at the same time with complete safety if left on their own is always a problem but in the Bescol 750 watt "Vanguard Panel Heater", this has been achieved. The automatic cut-out operates at a pre-set temperature. Should any clothing, etc. be placed over the grille, it switches itself off. A few moments after the removal of the obstruction, the heater switches itself on again. A Panel Heater of this type has many other additional uses and is offered in a range of colours including hammered bronze, citron green, lilac, green and white.

D5 BEST PRODUCTS LTD. Ranelagh House, Felixstowe, Suffolk. (Telephone: Felixstowe 3154/5/6 (3 lines)).

Best "Matchless" Electric Firelighter has proved in its first year the complete reliability of design. Operating from 5 amp plug, every known type of fuel can be ignited without the necessity of burying the nozzle in the fuel. By the use of a special sillimanite refractory, intense heat can be applied to surface face of the fuel—no burnt-out nozzles to replace.

This firelighter was designed to appeal to women—simple to adjust height and angle, safety key switch preventing misuse by infants, neon warning light to guide adults.

(*continued*)

✱ Everyone's installing the *NEW*-

don't miss out — send for coloured leaflet today . . .

the compact, pocket sized INCINERATOR with the giant sized capacity

Ideal for the disposal of the varied refuse arising in hospitals. Reduces fire hazard, releases floor space, improves standards of hygiene. Loading is easy. Ash removal is simple.

BOSTON *burns without smoke!*

VISIT OUR STAND No. **B.14**
and SEE A PRACTICAL DEMONSTRATION OUTSIDE THE EXHIBITION HALL

BOSTON MARINE & GENERAL ENGINEERING CO. LTD
Heath Town Works, Deans Road,
Wolverhampton
Telephone: 25125-6-7

Stand No.

The appliance can be "tucked away" after use by hanging or standing position—no more dirty hands, no paper, wood or chemical lighters—just heap the fuel and position the appliance. When switched on, this will blow a jet of intensely hot air into the fuel. Note there are no flames; simply air heated to 800°C.

SPECIFICATION: Voltage: 230/250v. AC Only. Special Orders Only, 200/220v. AC Only. Heater Element: 1,100 Watts. Colour: Attractive Hammered Bronze Body. Nozzle in Satin Finish Metal. Stand: Rigid Steel. Weight: 4½ lb. Complete with Stand and 6 ft. of 3-Core Non-Kinkable P.V.C. Flex. Approved by E.D.A.

B14 and outside Demonstration **BOSTON MARINE & GENERAL ENGINEERING CO. LTD., Heath Town Works, Deans Road, Wolverhampton, Staffordshire. (Telephone: Wolverhampton 25125).**

The Boston Smokeless Incinerator on display has the same efficiency associated with the larger Incinerators manufactured by this Company.

This model occupies less than 6 sq. ft. of floor space and is capable of burning all kinds of general refuse—smokelessly. Easily erected, it is complete in itself and fully insulated. Ideal for hotels, industrial premises, small supermarkets, small hospitals, clinics and schools, in fact, any place where rubbish has to be destroyed.

B8 **BRITISH COAL UTILISATION RESEARCH ASSOCIATION, Randalls Road, Leatherhead, Surrey. (Telephone: Leatherhead 4411).**

Research by B.C.U.R.A. which contributes towards cleaner air can be classified:-

1. Improving the efficiency of using solid fuel in boilers, industrial furnaces and in domestic appliances.
2. The study of methods of arresting grit, dust and smoke.
3. The study of methods of sampling and measuring the amount of grit, dust and smoke emitted into the atmosphere.

The following is a brief description of the exhibits illustrating this work:-

(*a*) A model in relief of an Economic Boiler shows how smokeless combustion and low grit emission can be achieved with coal firing, even at high loading, provided that control of air/fuel ratio and the moisture content of the coal is effective and provided that the distribution of the air under the grate is suitably apportioned.

(*continued*)

Stand No.

(*b*) A Vortex type burner for use with raw producer gas on each of the fireholes of intermittent brick kilns is one of the exhibits. It has overcome the heavy smoke emission which sometimes occurs with direct coal firing. Tests have shown that when these burners are used in a kiln firing facing bricks, combustion is practically smokeless.

(*c*) The principles governing the selection and performance of grit arrestors are illustrated by diagrams taken from a new B.C.U.R.A. publication entitled "Mechanical Equipment for Removing Grit and Dust from Gases" by R. Jackson. The book will be on sale.

(*d*) It is important that in determining the amount of grit, smoke and dust emitted from a chimney, the method of sampling should be reliable. The cyclone probe method devised by B.C.U.R.A. with its accessories will be exhibited. There will be a projector for showing slides which illustrate and describe this method of sampling.

(*e*) One method of determining whether the smoke emitted from industrial chimneys is at a satisfactorily low level is to compare the density of the plume with a Ringelmann Chart. The principles governing the use of this chart will be illustrated.

(*f*) The measurement of the smoke emitted from domestic chimneys is particularly difficult and work at B.C.U.R.A. has shown that a reliable test method is to collect and weigh all the smoke. This is done by fixing an electrostatic precipitator on the chimney top and weighing it before and after. The precipitator will be shown and the staff will explain how it is used.

Enquiry Bureau, Conference Office

BRITISH RAILWAYS (North Eastern Region), Public Relations and Publicity Office, York. (Telephone: York 53022).

A train information and inquiry bureau is situated in the Conference Office in the Spa Ballroom (Hall "D"). It will be staffed by British Railways personnel who will be pleased to answer delegates' and visitors' inquiries regarding train times and connections.

A22 **BRITISH STANDARDS INSTITUTION, British Standards House, 2 Park Street, London, W.1. (Telephone: MAYfair 9000).**

The Institution's exhibit consists of a display of building standards and codes of practice related to the theme of the exhibition with details of how advantage may be taken of the work of B.S.I. in this and other fields.

Stand No.

A6 CANNON INDUSTRIES LTD., Gas Appliance Division, Deepfields, Bilston, Staffordshire. (Telephone: Bilston 41241/5).

CANNON are displaying their range of GasMiser fires.

The GasMiser was the first gas fire to make possible continuous room heating by gas at a price cheaper than coal burnt in an open fire. Over half a million homes have already discovered the comfort and proved the economy of the GasMiser.

Now with a new pleasantly modern styling and choice of four gleaming vitreous enamel lustre finishes, GasMiser is the most attractive fire you can buy.

GasMiser's brilliant radiant panel not only forms a cheerful focal point—particularly for those who are just replacing an open solid fuel fire—but also ensures the rapid warming up of the average sized room even in the coldest weather.

The tremendous heat output from this large radiant panel plus an adequate balance of convected heat provides the most efficient possible way of heating a room for maximum bodily comfort.

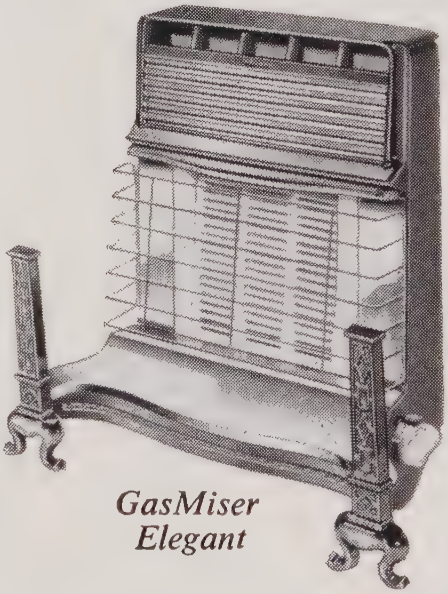
The GasMiser has been designed to give a tremendous heat output—it will quickly cope with the coldest conditions—that "First Hour" in the evening for those at work all day. Full on, it gives far too much heat for Continuous Heating of an average size room. *(continued)*

Cannon "GasMiser"

Britain's Most Popular Fire

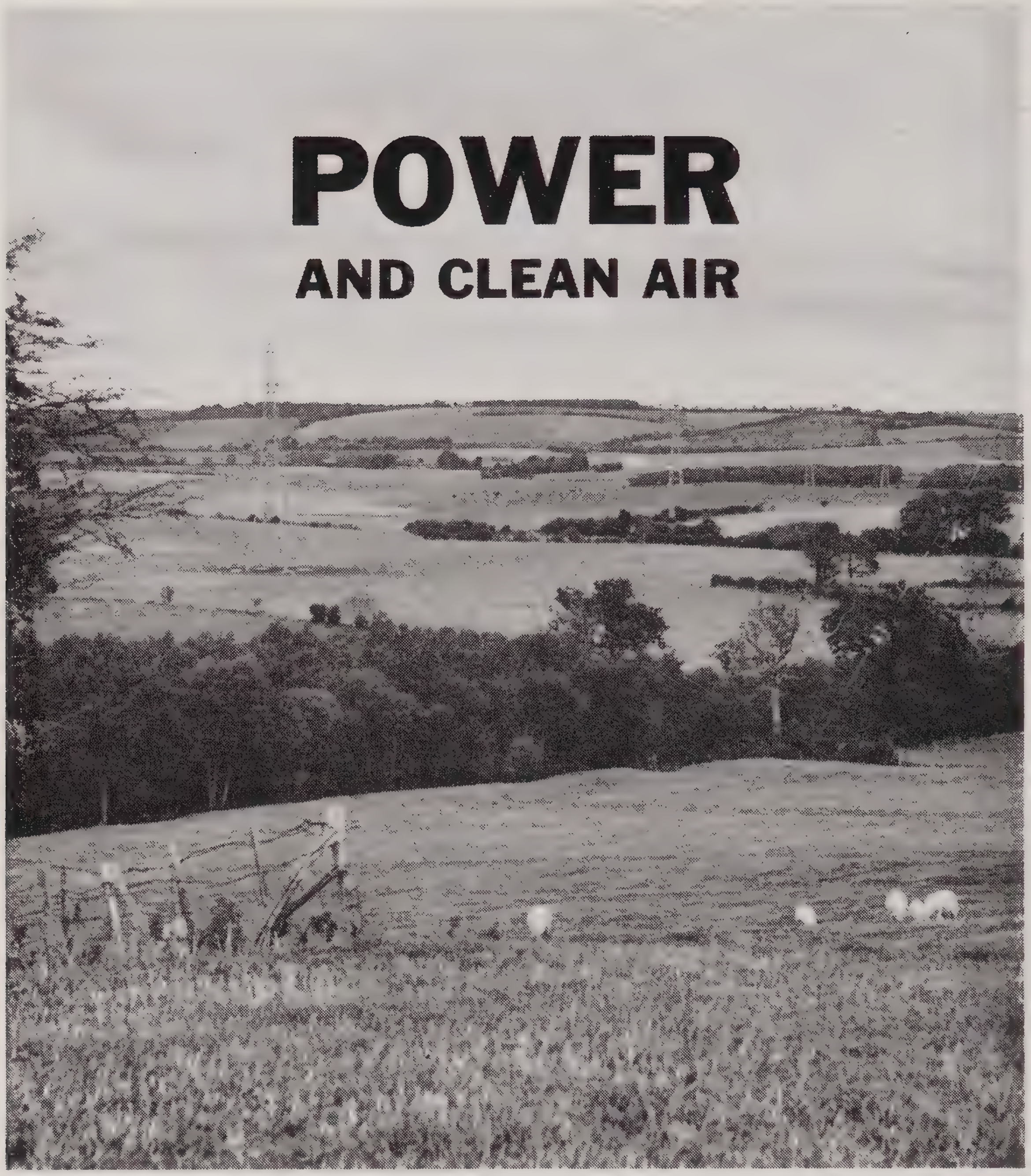
The tremendous heat output from GasMiser's large radiant panel plus an adequate balance of convected heat from the multy-jet convector, provides the most efficient possible way of heating a room for maximum bodily comfort.

The brilliant radiant panel not only forms a cheerful focal point—particularly for those who are just replacing an open solid fuel fire—but also ensures the rapid warming-up of the room even in the coldest weather—**and there is a GasMiser to heat the larger room.**



GasMiser Elegant

FROM ALL GAS SHOWROOMS AND AUTHORISED DEALERS



Electricity is a smokeless fuel and its provision by the Central Electricity Generating Board is a major contribution to clean air.

Moreover, it is the Generating Board's policy that strict attention be paid to power station chimney emissions.

Visit the C.E.G.B. stand. See how much the Generating Board have done and what they are doing, to further the cause of Clean Air.

CEGB

Stand No.

A simple dial fitted to the side of the GasMiser gives you a choice of 8 temperatures maintained automatically by GasMinder—a thermostat fitted in the bottom of the fire where it is affected by air at room temperature, drawn in at floor level.

The GasMinder increases and reduces the gas consumption to maintain the comfortable temperature you select and prevents you wasting gas—and money.

A12 to A14 **CENTRAL ELECTRICITY GENERATING BOARD, Bankside House, Summer Street, London, S.E.1. (Telephone: WATerloo 2011).**

Much progress has been made in dealing effectively with the vast quantities of flue gases arising from the combustion of fuel in power stations to ensure that they are harmlessly dispersed in the atmosphere. Dust arrestor plant, guaranteed to be capable of removing 99·3% of the dust from the gases leaving the boilers, is being installed at a cost of £2 millions in a 2,000 MW power station. A further £500,000 may also be spent on the chimney at such a station.

A considerable research effort is devoted to the practical and theoretical aspects of the dispersal of the flue gases and to the measurement of dust fall and sulphur dioxide in the vicinity of power stations. The display presented by the Generating Board shows in some detail how this work is carried out by the Central Electricity Research Laboratories, Leatherhead, Surrey.

A4 and A5 **COAL UTILISATION COUNCIL, 19 Rochester Row, London, S.W.1. (Telephone: VICtoria 2339). And at Aberdeen, Birmingham, Bristol, Cambridge, Cardiff, Edinburgh, Glasgow, Leeds, Manchester, Newcastle-upon-Tyne, Nottingham, Plymouth, Reading and Tunbridge Wells.**

The Coal Utilisation Council is a non-commercial organization for promoting the efficient domestic use of solid fuels. In existing or proposed smoke control areas the Council's policy is aimed at the retention of the domestic market for solid fuel either by the smokeless burning of coal for example, by means of mechanical stokers or by the use of smokeless solid fuel in modern approved appliances in the home, examples of which are on display. The Memorandum on Smoke Control Areas published by the Ministry of Housing and Local Government quotes the Coal Utilisation Council as one of the organizations from which local authorities contemplating the establishment of smoke control areas may obtain advice and assistance.

The various publications issued by the Coal Utilisation Council are displayed, including a list of Approved Domestic Solid Fuel

'COALITE'
burns cleanly
in every grate

'COALITE' is the modern smokeless coal for all open fires.

'COALITE' **NUTS** are the ideal solid smokeless fuel for modern boilers, cookers and stoves.

Both fuels are clean to handle, clean to burn, and authorised for use in smokeless zones.

Coalite and Chemical Products Ltd., Chesterfield, Derbyshire.
Telephone: Bolsover 2281/6

Stand No.

Appliances (published jointly with the Solid Smokeless Fuels Federation) from which solid fuel burning appliances for replacement in smoke control areas must be chosen.

On display is a full range of the latest type of tested and approved appliances, including open fires, room heaters, cookers, domestic and heating boilers, all of which are specially selected for use in clean air areas. Displayed under fire as working exhibits will be an open fire with high duty boiler heating three radiators and hot water, a freestanding room heater and an inset room heater in attractive settings.

Information is obtainable on the stand of the training facilities available to local authorities and the trade. These courses deal with the various types of solid fuel heating appliances and the problems arising in their installation.

The Women's Advisory Council on Solid Fuel has an information section on the stand and members of the staff will be present to discuss with delegates any assistance which can be given to local authorities promoting smoke control areas through women's meetings, etc.

B3 **COALITE & CHEMICAL PRODUCTS LTD., P.O. Box 21, Chesterfield, Derbyshire. (Telephone: Bolsover 2281).**

Live "Coalite" fires in open fire and cooker can be seen on the Stand. Large "Coalite" is the ideal smokeless fuel for every type of domestic grate, old or new, and openable or closeable stoves and hot water boilers.

"Coalite", which is very reactive, will laze or blaze according to requirements. It may be allowed to laze throughout the night or on other occasions when not required, but will draw up to a cheerful blaze immediately the air regulator is opened.

"Coalite" is readily ignited in the ordinary way with paper and sticks, fire lighter or gas poker and burns cheerfully with flame giving radiant heat, maximum comfort and economy.

"Coalite" is equally suitable as best house coal for the open fire and can be obtained from all leading coal merchants.

Prices vary throughout the country according to the geographical position in relation to the Works and carriage charges that are involved. It is sometimes said that "Coalite" is expensive and whilst it may be true when this is considered initially in terms of shillings per hundredweight, the important point is that one buys by weight and consumes by volume. As "Coalite", all of which burns away without risk of flying pieces, is of greater volume than coal, it is cheapest in the long run.

It is most important to note that "Coalite", which is an approved smokeless coal, will burn satisfactorily in any type of grate or appliance without the expense of alteration.

Stand No.

A16 and A17 **COLLECTRON LIMITED, 32 Aylmer Road, Leytonstone, London, E.11. (Telephone: LEY 3085/4709).**

In the field of high efficiency dust collectors, the use of small diameter cyclones coupled with bag filters often results in blockages, causing blow-backs and high replacement and handling costs. An entirely new dust collector, known as "Collectron" has been developed recently which is producing a high degree of precipitation in a primary cyclone type chamber. The air or gas flow leaving this chamber still carries a certain amount of the finer dust which is extracted by a sleeve into a high velocity re-cycling circuit. The dust is carried through the re-cycling fan and returned into the primary chamber where it is mixed with the incoming, heavily dust-laden gas, which further assists in precipitation of the fine particles. A high degree of collection, comparable to electrostatic precipitators or fabric filters is obtained.

Collectron units maintain a high collecting efficiency through the whole range of particle sizes, even down to 2 microns. This is in contrast with other dry dust collecting units at present in use where the efficiency begins to fall off rapidly between 12 and 50 microns.

Single units capable of handling up to 4,000 ft.^{3} of air or gas per minute with very high grain loadings, are in production. Ground ball clay containing 2½ per cent. moisture was collected in a single unit with an efficiency of 98·2 per cent. and the quantity handled was 3½ tons per hour.

A1 **COMBUSTION EQUIPMENT LTD., 61 Belsize Lane, London N.W.3. (Telephone: Swiss Cottage 4462/3).**

The "Cory" Grit Arrester and the "Dribore" Stack will be featured on the stand. The "Cory" grit arrester is of the centrifugal flow type. The radial assembly of swirl blades causes the grits to be thrown outward by a centrifugal force where they are trapped in an annular chamber and allowed to fall into the grit pipes, which conduct them to the point of collection. There are no moving parts and the draught loss through it is very small. The provision of fans is not usually necessary. It is made in both horizontal and vertical types and in corrosion resistant steel where conditions of service are arduous.

The "Dribore" stack is of double skin construction in mild steel, with a gap of ⅝ in. between each skin. The insulating medium is stagnant air aided by two sheets of aluminium foil. Special construction at the flanges provides for the differential expansion of the two skins and erection is by bolting sections together in the same simple manner as for single skin stacks. The design of cone bases, gas inlets etc. is exactly the same as in single skin stacks.

Stand No.

D30 CORSECTRIC LTD., 6 Cadogan Lane, Belgravia, London, S.W.1. (Telephone: BELgravia 8306/7/8).

Puritron Electronic Air Purifiers, which are manufactured in the United States, have now been introduced to Great Britain. Operating on the principle of negative ionisation of the atmosphere in rooms, the Puritron Units transform a stale, germ laden, polluted, smoky atmosphere into clean spring-fresh air, without using ducts, pipes or ventilation devices. Puritron cleans and purifies the air—kills germs—removes offensive odours and tobacco fumes. Pollen and airborne irritants are destroyed and pure fresh air is continually circulated. The units are specially beneficial to sufferers from Asthma, Hay Fever, and other Respiratory Diseases.

The remarkable results produced by Puritron electronic air purifiers are achieved by a combination of four processes.

(i) Stale air is drawn by fans by high efficiency mechanical filters.

(ii) Odours are oxidised by concentrated oxygen.

(iii) The air is then subjected to germ destroying ultra-violet rays.

(iv) Finally, the purified air is highly charged with negative ions at the rate of 12 billion per second before it is recirculated into the room.

(*continued*)

Plug in . . .
switch on . . .
and enjoy . . .
pure, fresh
PURITRON air

PURITRON decontaminates stale germ-laden air and absorbs tobacco fumes by *electronic ionisation*.
Keeps *bars* and *public rooms* germ-free and spring fresh.
Portable units require no ducts or ventilation, from **£26 5 0** tax paid.
Electric consumption negligible.

Write for details to:—
CORSECTRIC LIMITED
6 Cadogan Lane, London, S.W.1
Tel.: BELgravia 8306

Puritron

PURITRON UNITS ARE BEING DEMONSTRATED ON STAND No. D30

Estd *1829*

Banking Facilities at the National Clean Air Exhibition

All exhibitors and visitors are invited to make full use of the banking facilities which we have made available in the Exhibition Hall at Scarborough from October 8th to 11th.

Our representatives will be pleased to see you.

DISTRICT BANK

LIMITED

OVER 570 BRANCHES AND STEADILY EXPANDING

Principal Yorkshire Branches: BRADFORD, HALIFAX, HARROGATE, HEBDEN BRIDGE, HUDDERSFIELD, HULL, LEEDS, MIDDLESBROUGH, SHEFFIELD, TODMORDEN, WAKEFIELD, YORK

Three models are available for use on the office desk, or in medium and large sized rooms. They operate from any 220/240 AC electrical supply, and only require to be plugged into a convenient point to operate effectively. Very little maintenance is required beyond actual cleaning of the filter, and the electricity consumption is very low.

The Puritron Gold Tube and Puritron Unit are fully protected by world patents, and are distributed by Corsectric Ltd., of 6 Cadogan Lane, London, S.W.1, Telephone: Belgravia 8306 or 3549.

B5 **DAVIS ESTATES LTD., Builders of Homes, 350 Kilburn High Road, London, N.W.6. (Telephone: MAIda Vale 6011).**

A contribution to the Clean Air Campaign by one of Britain's leading Estate Developers. On display are new and challenging designs of houses and bungalows incorporating full central heating designed to maintain an inside temperature of around 70°F. in the living room and 55/60°F. in bedrooms and other areas when the outside temperature is 30°F.

In designing, the Architects were instructed to consider economy in running costs and to provide adequate insulation to ensure that heat provided by the central heating system is not wastefully dissipated, The cavity walls are faced internally with the foil backed insulating plaster board dry lining yielding a standard of thermal insulation approximately twice as good as that achieved by an ordinary 11 in. cavity wall. The insulating foil also forms a vapour barrier so that the inside surfaces of external walls remain warm and dry in all weather conditions.

This degree of insulation, mandatory in countries where central heating is in common use, enormously increases standards of comfort; it also eliminates condensation and provides a longer life for decorative finishes.

Also incorporated in these latest designs are Pierson windows —sliding, sashless picture windows that open. Freedom from draughts, easy operation and panoramic vision are advantages in themselves, but even more important is the fact that a second set of glazing can be added at any time, thus providing the benefits of increased thermal and sound insulation that only double glazing confers.

Featured are walk-in wardrobes equipped with sliding/folding Pividors, internal duct plumbing, specially designed staircases constructed in Sapele hardwood with pre-moulded Sapele-faced treads and risers.

The complete new range of properties consists of seven basic types, each constructed to the same module, thus contributing to flexibility of lay-out. Plans and models are on view.

Get in on the CLEAN AIR ACT with ELECTRICITY

Electricity provides the cleanest heat there is – there is no dirt, smoke or fumes. That is why it makes a unique contribution to the Clean Air Act. And now it does this in new and exciting ways.

Electric central heating for everyone. The new Unit-plan storage heaters are cheap to buy and install (from about £70 for two heaters). And, because they use electricity at off-peak rates, very economical to run. Another form of electric central heating for new houses which also uses off-peak electricity, is electric floor warming.

Plenty of hot water cheaply. The fixing of an immersion heater is the simplest and cheapest way of adapting an existing water heating system. Electricity heats water swiftly, cleanly and, provided there is efficient lagging, economically.

Modern electric cooking is fast and clean. Electric cookers keep kitchens clean and free from condensation, mean less redecoration. And, new electric cookers are very *fast*. The new radiant rings and lightweight boiling plates heat up (and cool down) in a matter of moments.

Ask your Electricity Board for the free leaflet "When your neighbourhood becomes a Smoke Control Area . . . here's how Electricity can help you", or write to the Electrical Development Association (P/CC), 2 Savoy Hill, London, W.C.2

VISIT *Electricity* STAND No. A9,10,11

Stand No.

B9 **DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, State House, High Holborn, London, W.C.1. (Telephone: Chancery 1262.**
WARREN SPRING LABORATORY, Stevenage, Hertfordshire. (Telephone: Stevenage 2080/8).

A small wind tunnel mounted on the stand is being used to demonstrate typical behaviour of plumes from chimneys sited near to large buildings.

Wind-tunnel tests on models are frequently used to predict the pattern of dispersion of flue gases from a new chimney installation. Although such tests have been in use for many years, no thorough study appears to have been made of the extent to which the model tests reproduce full-scale behaviour in practice.

This is now being investigated in a co-operative study by Warren Spring Laboratory and the National Physical Laboratory. Dispersion from a full-scale experimental chimney constructed at the Warren Spring Laboratory is being compared with that in wind-tunnel tests at the National Physical Laboratory.

A8 **DISTRICT BANK LTD., 17 Spring Gardens, Manchester, 2. (Telephone: DEAnsgate 4300).**

All exhibitors and visitors are invited to make full use of the banking facilities which we have made available in the Exhibition Hall at Scarborough from October 8th to 11th.

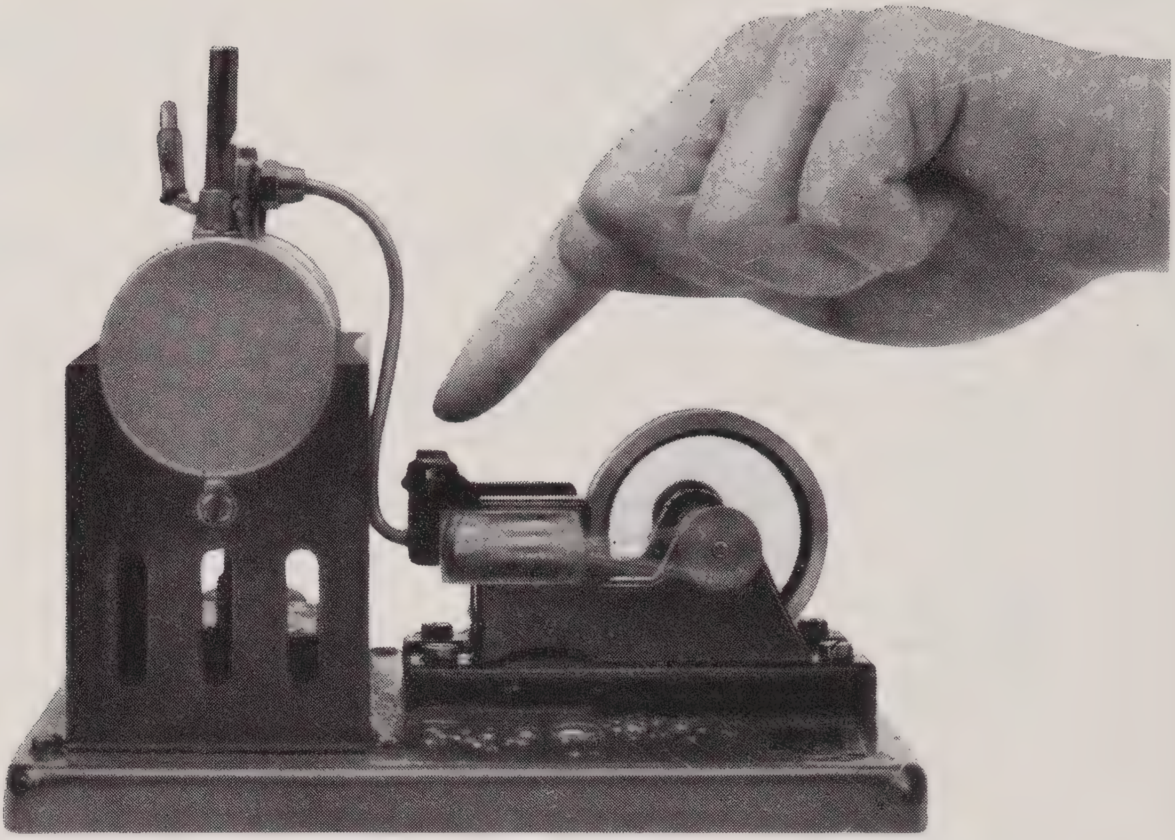
Our representatives will be pleased to see you.

A9 to A11 **ELECTRICAL DEVELOPMENT ASSOCIATION, 2 Savoy Hill, London, W.C.2. (Telephone: Temple Bar 9434).**

Visitors to the E.D.A. exhibit will be able to see some of the ways in which Electricity, the versatile "fuel", may be used to the advantage of the individual and the community.

Electric Space Heating. Electric floor warming is now an accepted method of heating new houses, flats and commercial and industrial buildings. This system, which uses electricity "off-peak" when supplies are plentiful and almost half price, is ideally suited to municipal properties where low installation and running costs matter most. For conversions or public buildings, storage block heaters operate on the same low rates for electricity taken "off-peak".

Electric Water Heating. Cheaper "off-peak" electricity is also available for water heating. Installation of the special "off-peak" electric water heaters is simple and inexpensive, and they are particularly suitable for municipal houses and flats. (*continued*)



ELLIOTT MAKE CHILD'S PLAY OF BOILER CONTROL

Vast experience in instrument making, and the application of instrumentation to industrial processes, enable us to provide a unified, *comprehensive* service for the instrumentation and control of boiler and furnace plant of all types.

We advise *on every phase* of your problem: initial examination, the correct application of your particular plant, followed up by detailed specifications and estimates.

No task is too big or too small for us. Your contract is handled by specialist engineers, behind whom stand the technical and manufacturing resources, the after-sales service and maintenance, of the largest instrument company in Europe.

An Area Engineer, fully experienced in every detail of customer application is resident in London and the Home Counties, Newport, Birmingham, Stockport, Newcastle, Glasgow and Dublin.

Please Contact:

ELLIOTT

ELLIOTT PROCESS AUTOMATION LTD
ABBEY ROAD · PARK ROYAL · LONDON · NW10
Tel: ELGar 7641 Telegrams: ELFLOMETA, LONDON. Telex No. 23196

EA A Member of the Elliott-Automation Group

Electric Cooking. Electricity is now established as the most popular "fuel" for cooking—this is because it is cheapest and cleanest. Amongst the electric cookers on show are some designed specially for municipal housing schemes.

Electric Refrigeration. Many local authorities are now making available to tenants some form of refrigeration and on health grounds alone this can be justified. On show is one of several built-in models available for housing schemes.

Garbage Disposal. In blocks of flats, especially, the quick disposal of waste matter is important and an electric under sink unit to deal with the problem is on show. For the safe and hygienic disposal of surgical dressings, etc., a very efficient electric incinerator is displayed.

Electric Fire Lighters. A selection of electric fire lighters, specially developed for use with solid smokeless fuels is on display.

House Wiring. The importance of adequate wiring for domestic premises is emphasized, and a display feature introduces the new E.D.A. publication, "The design of homes for to-day and tomorrow".

A friendly staff will welcome you to the exhibit and is ready to answer your questions on electricity supply or utilization. A wide range of E.D.A. literature is yours for the asking.

D31 ELLIOTT PROCESS AUTOMATION LTD., (A member of the Elliott-Automation Group) Abbey Road, Park Royal, London, N.W.10. (Telephone: ELGar 2111).

Emphasis this year is on air pollution and clean air with respect to boiler and furnace efficiency of combustion, associated with instrumentation control by means of gas analysis, dust monitoring and smoke density measurements.

D25 FEDERATED FOUNDRIES LIMITED, 75 Hawthorn Street, Glasgow, N.2. (Telephone: POSsil 8622). London Showroom: 4 Stratford Place, W.1. (Telephone: MAYfair 5054).

This Company manufacture the well known range of Sofono Solid Fuel and Electrical Heating Appliances. The Sofono fires, Full-View, Low-View, Rural Mark II and Grange can be used along with the normal duty back boiler for domestic supply or the high duty back boiler for domestic supply and background heating. With any of these fires, the Sofono Underfloor Air Unit gives greater output and enables any kind of Smokeless fuel to be used, including Sunbrite.

(*continued*)

AIR POLLUTION
DUST MONITORING
PARTICLE SIZING

Do you have problems connected with any of the above? If so visit our **Stand D.32** and see our instruments being demonstrated

Air Pollution Monitor Mark II

Radio-Active Dust Sampling Equipment

Aerosol Spectrometer 501

Double Image Micrometer and Particle Size Analyser

FLEMING INSTRUMENTS LIMITED

CAXTON WAY · STEVENAGE · HERTS.

STEVENAGE 804/8

Federated Foundries are also the patentees of the well-known F.F. Joint which is universally accepted for its aid to plumbing, both in cost and efficiency.

In their range—Federated Foundries also have their well-known baths, the "Viscount", "Viceroy", "Squire", "Morna", and "Shiel".

D32 FLEMING INSTRUMENTS LTD., Caxton Way, Stevenage, Hertfordshire. (Telephone: Stevenage 804/8).

The Aerosol Spectrometer, sampled at either ½, 1 or 2 ccs. per min. is introduced along the axis of a horizontal settlement duct forming part of a closed system through which clean "winnowing" air is circulated at 100 ccs. per min. All the particles are carried along the duct at the velocity of the winnowing air and settle under gravity at their individual falling speeds.

For spherical particles of unit density, the spectrum extends from about 20μ to 1μ using a winnowing air speed of 100 ccs. per min. (i.e. that used in the standard instrument). If special equipment is used, so that a winnowing air speed of 400 ccs. per min. is produced, the range would be 40μ to 2μ.

The Air Pollution Monitor Series II instrument monitors continuously the pollution of the atmosphere and the sensitivity of the instrument is such that its application in the detection of air pollution is very wide, from early detection of leaking filters in a chimney exhaust to monitoring pollution levels in a clean atmosphere. It will also detect colourless particles with equal facility.

Basically the standard instrument consists of a filter paper and its drive mechanism, through which air is drawn by a diaphragm vacuum pump. This creates a pressure differential across the filter paper which increases as particles in the air clog the paper. These pressure fluctuations, caused by pollution of the air, can be recorded externally on a strip recorder and also operate an external alarm signal by a pressure sensitive switch that can be preset to detect any desired level of pollution.

The Fleming-Timbrell Double Image Micrometer and Particle Size Analyser instrument accurately sizes particles in the range 1-250μ and can classify them into 10 size groups automatically on a counter panel with the minimum of fatigue to the operator. Ask to see a demonstration.

Standards of Health are growing higher

CLEAN HEAT **CLEAN AIR**

WITH... ...HIGH SPEED GAS and COKE

Smokeless Gas and Coke (and named solid fuels), burned in the latest equipment, offer the cleanest means of obtaining plentiful hot water and comfort-warmth—by central heating, warm air heating, radiant/convector gas fires or closed and open coke-burning appliances.

For the best advice on room heating, water heating and cooking with smokeless fuels, consult your Gas Board.

Be sure to visit . . .

STANDS D21/22 (GAS) and D2 (COKE)

ISSUED BY THE GAS COUNCIL

Stand No.

D1 and D2 (Coke) D21 and D22 (Gas)

THE GAS COUNCIL 1, Grosvenor Place, London, S.W.1. (Telephone: BELgravia 4321).

The Gas Council's two stands (GAS No. D21-22 and COKE No. D2) are centres of up-to-date information on how the use of Gas and Coke in home and factory is contributing to the ideal of a smokefree Britain.

Inasfar as the domestic chimney is responsible for emptying nearly half of the smoke over this country, the use of gas in the home is of particular value in fulfilling the requirements of the Clean Air Act. Installation of modern gas-burning appliances is easily accomplished; a gas cooker, sink heater, refrigerator, clothes washer or boiler, will fit compactly into the kitchen, while a gas radiant convector room heater will give instant warmth in a living room or bedroom, and eliminates all the dirt and drudgery arising from smoke pollution. Of special interest in the domestic field are the new developments in central heating displayed on the stand which satisfy both the need for clean air and greater comfort. They include "small bore" central heating which can be installed in existing houses with a minimum of structural alteration, and for a reasonable capital outlay; also gas warmed air heating systems which give either economical "selective" heating or full comfort in all rooms, passages and halls, throughout a house or flat. In addition, a gas circulator, heating a water tank or cylinder, can be fitted to an air heating unit to provide constant hot water all the year round.

The Gas Industry's Solid Smokeless Fuel makes an excellent alternative for winter space heating and water heating; a coke-fired boiler will give a combined central heating and hot water service in the most economical way possible; or coke will give all-day warmth and comfort with similar economy when it is burned either in an open fire or in a heating stove: both types of fire can be fitted with back boilers to give a full hot water supply at little extra cost. Coke fires can be banked up to stay alight for long periods (or overnight). Open fires are also available with built-in gas burners which ignite the fire quickly.

Gas and Coke, in brief, used either separately or in combination, provide the family with new comfort standards and meet perfectly all the requirements of the Clean Air Act for the domestic use of smokeless fuel.

Delegates are invited to visit the Gas Council's two stands, where expert advice on gas and coke and its contribution to clean air can be obtained.

Stand No.

D17 G.E.C. (DOMESTIC EQUIPMENT) LTD., Langley House, Hanger Lane, Ealing, London, W.5. (Telephone: PERivale 6691).

On their stand, G.E.C. set the trend in home heating with their full range of up-to-the-minute fires, heaters and radiators.

The **"Tropicana Turbo Heaters"** are some of the most efficient, versatile and well-designed heaters on the market. They provide both instant background warmth and direct heat at the touch of a switch. They can also be used as a hair-drier or as a fan, at one or two different speeds. Some models are provided with a 48-hour timer which switches the heat on at a pre-selected time and some have thermostats which turn the heat off when the room has reached the desired temperature.

The slender oil-filled radiators are ideal for central heating. They fit discreetly and unobtrusively under windows and along skirtings, their elegant duo-tone finish with gold trim blending admirably with any decor.

For convected heat with a radiator effect, there is a handsome range of convectors and skirting heaters, either portable or wall-mounted. Many of the models are illuminated to give a cosy glow and some of them are fitted with thermostats and timers for precise heat control.

Both Infra-Red and Radiant fires provide direct warmth with a cheerful red glow for additional comfort. The Infra-Red heaters are ideal for use in kitchen and bathrooms, because the totally enclosed elements make them absolutely safe for use in a steamy atmosphere.

The range of fuel effect fires, with their glowing "logs" and cheerfully burning "coal", are excellent choices for dining-room, living-room or lounge.

There are over 45 models to choose from, providing every kind of heat—from the gentle background variety to infra-red—to suit all tastes and pockets.

D19 and D20 HEAD WRIGHTSON IRON & STEEL WORKS ENGINEERING LTD., Teesdale Iron Works, Thornaby-on-Tees, Yorkshire. (Telephone: Stockton 62241).

Head Wrightson Iron & Steel Works Engineering Ltd., are showing details of the equipment they can offer as a complete gas cleaning service to industry. This will include:

(*continued*)

Flooded Disc Scrubber

This is a high efficiency scrubber capable of collecting submicron particles from process gases. It will give weight efficiencies in excess of 99 per cent and is an ideal unit for the collection of electric furnace, open hearth, oxygen-blown converter and cupola fumes as well as dusts and fumes from all processes in the cement, lime, foundry and chemical industries.

A unique feature of this scrubber is its ability to operate at constant efficiency over a wide range of flow rates. This is achieved by automatically adjusting the position of the scrubbing disc within the tapered scrubber casing so as to maintain constant pressure drop and efficiency.

Cyclo-trell

The Cyclo-trell is a multi-tubular centrifugal collector ideally suited for the high efficiency collection of process dust. It is relatively cheap and compact, has a low power consumption and requires little maintenance. It is frequently used as a pre-cleaning to reduce the load on a secondary collector.

Fabric Filters

These filters can be offered for the collection of all dry dusts and fumes at efficiencies exceeding 99·5 per cent. A complete range of natural organic-synthetic and fibre glass fabrics is available for use in the units and gases at temperatures of up to 500°F can be handled by them.

Electrostatic Precipitators

Head Wrightson-Research Cottrell precipitators offer all these advantages.

Low maintenance—no expert attendance or expensive replacement parts.

Low draught loss—the pressure drop between inlet and outlet is extremely low—averaging only a few tenths of an inch of water.

Low power cost—at the high voltage necessary to maintain the electrical field, the current and power requirements are extremely low.

Durability—installations made more than twenty-five years ago are still operating without appreciable change or loss of efficiency.

Any temperature—up to 1,200°F, or even higher, depending on the application and materials used in construction.

Any capacity—from a few hundred c.f.m. to several million c.f.m.

A visit by delegates attending the conference to our works at Thornaby-on-Tees has been arranged for Thursday, October 10.

LEO·FI—The *ONLY* Radiant Oil Heater Government *APPROVED* for *GRANT* in Smoke Control Areas

Heats the average size room for LESS than 1½d an hour

Superbly finished in STAINLESS STEEL

RETAIL PRICE £15/19/4

. . . . *UNEQUALLED for*

ECONOMY, COMFORT and CONVENIENCE

- ✱ Maximum heat output equals 3 Kilowatts
- ✱ Thermostatic vent takes fumes UP chimney
- ✱ Air-cooled COPPER tank
- ✱ Fits SECURE in the Fireplace
- ✱ Completely unaffected by up or down draughts

STAND B7

Can be left Day and Night *UNATTENDED*

Send for FREE Colour Brochure

LION STAMPING Company Ltd
Marshgate Lane London E.15.

Stand No.

B7 LION STAMPING COMPANY LIMITED, 35 Marshgate Lane, Stratford, E.15. (Telephone: MARyland 5161).

In the field of domestic space heating nothing has been so spectacular as the increasing popularity of the radiant oil heater, and today over four million appliances of this type are used in homes throughout the country. Provided the purchaser has chosen wisely, they can expect to secure warmth at a fraction of the cost of other forms of heating, combined with a higher standard of comfort and convenience.

In no small measure is the rapid development of this type of heater due to the Lion Stamping Company Limited whose specialized experience in both the domestic and industrial fields covers a period of nearly a quarter of a century. It was in 1946 that this company pioneered the first gravity-feed heater on the market and today millions of heaters bearing the familiar "Leo" trade-mark are in use throughout the world. Never content with the proven high efficiency of its free-standing models, the company's technicians have since 1956 devoted their energies to perfect a design to meet the requirements of most households—*a model that could be fixed safe* and *secure* in the *fireplace*. After much laboratory research and building special testing units to provide the most exacting chimney conditions, the Leo-Fi flued space heater was developed.

With the average sized room, this heater costs 1s. 3d. per day to run and makes this by far the most economical form of heating, combined with the highest standard of comfort and convenience.

Clean Air Act: The Leo-Fi fully complies with the provisions of the Act and is eligible for the 7/10th grant applicable to householders complying with a Smoke Control Order. You are cordially invited to inspect this unique model on our stand and obtain copies of the illustrated descriptive brochure containing full specification.

D13 "LOCAL GOVERNMENT CHRONICLE" (Charles Knight and Co. Ltd.), 11-12 Bury Street, St. Mary Axe, London, E.C.3. (Telephone: MANion House 5477).

You are invited to call at our stand for a copy of *The Local Government Chronicle*, the old-established municipal weekly paper with the new look. Widely recognized by local government officers as reliable and a great help to them in their work, the "*L.G.C.*" carries surveys and articles on new legislation as well as prompt and discerning coverage of all major happenings in local government.

(*continued*)

ME WELCOMES YOU

to Scarborough

MUNICIPAL ENGINEERING

(Local Governments' leading Technical Weekly)

Not only the best periodical in your particular sphere, but now offers fortnightly Data Sheets and regular pull-out Supplements . . .

Real value for Money - still only £2-12-0 for a year's subscription . . .

Can YOU afford to miss it?

Municipal Engineering, 3 Clement's Inn, London W.C.2
Phone: Holborn 5509

The "*L.G.C.*" is something of an institution in local government as its very wide readership bears witness. Each year, an independent audit is carried out on its circulation by the Audit Bureau of Circulations. This reveals that it has the highest A.B.C. audited circulation in the field of municipal weeklies—and its growth in recent years has been accelerated.

The paper was founded in 1855 by Charles Knight, the versatile author, editor, printer and publisher—best known perhaps for his "Penny Cyclopaedia", the forerunner of the modern encyclopaedia. Among his publications which flourish to this day is "Knight's Public Health Acts". With the advent of the public health legislation of the 1870's, the paper grew and expanded—and raised its price to 3d.

Still published by the firm of Charles Knight & Co. Ltd., *The Local Government Chronicle* now costs 1s. 3d. weekly on order from any newsagent or can be obtained direct from the publishers at 11-12 Bury Street, London, E.C.3, at £3 18s. per annum, postage included.

D15 and D16 **MINISTRY OF HOUSING AND LOCAL GOVERNMENT, Whitehall, London, S.W.1. (Telephone: WHItehall 4300).**

A century of progress under the Alkali Acts is shown in pictures on the Ministry's stand under the title of "Industry Clears the Air". Photographs of model manufacturing plants are contrasted with old works. Items of historic interest such as the first Alkali Act, 1863, and equipment in use at that time, and reproductions of the first registrations under the Alkali Act are shown on the stand.

D11 **MUNICIPAL JOURNAL GROUP OF COMPANIES, 3-4 Clement's Inn, London, W.C.2. (Telephone: HOLborn 2827).**

This Group of Companies will display on their stand: *Municipal Engineering*, *The Municipal Journal*, *The Municipal Year Book*, and sundry books and official publications, published by the Group on behalf of various Associations.

Municipal Engineering caters specifically for the technical officers of local government and in particular the Public Health Inspector, Cleansing Officer and the Engineer and Surveyor. It is in fact *the* technical weekly journal of local government and the only weekly publication with such extensive coverage of public health and cleansing and now publishes invaluable Engineering Data Sheets as a fortnightly supplement.

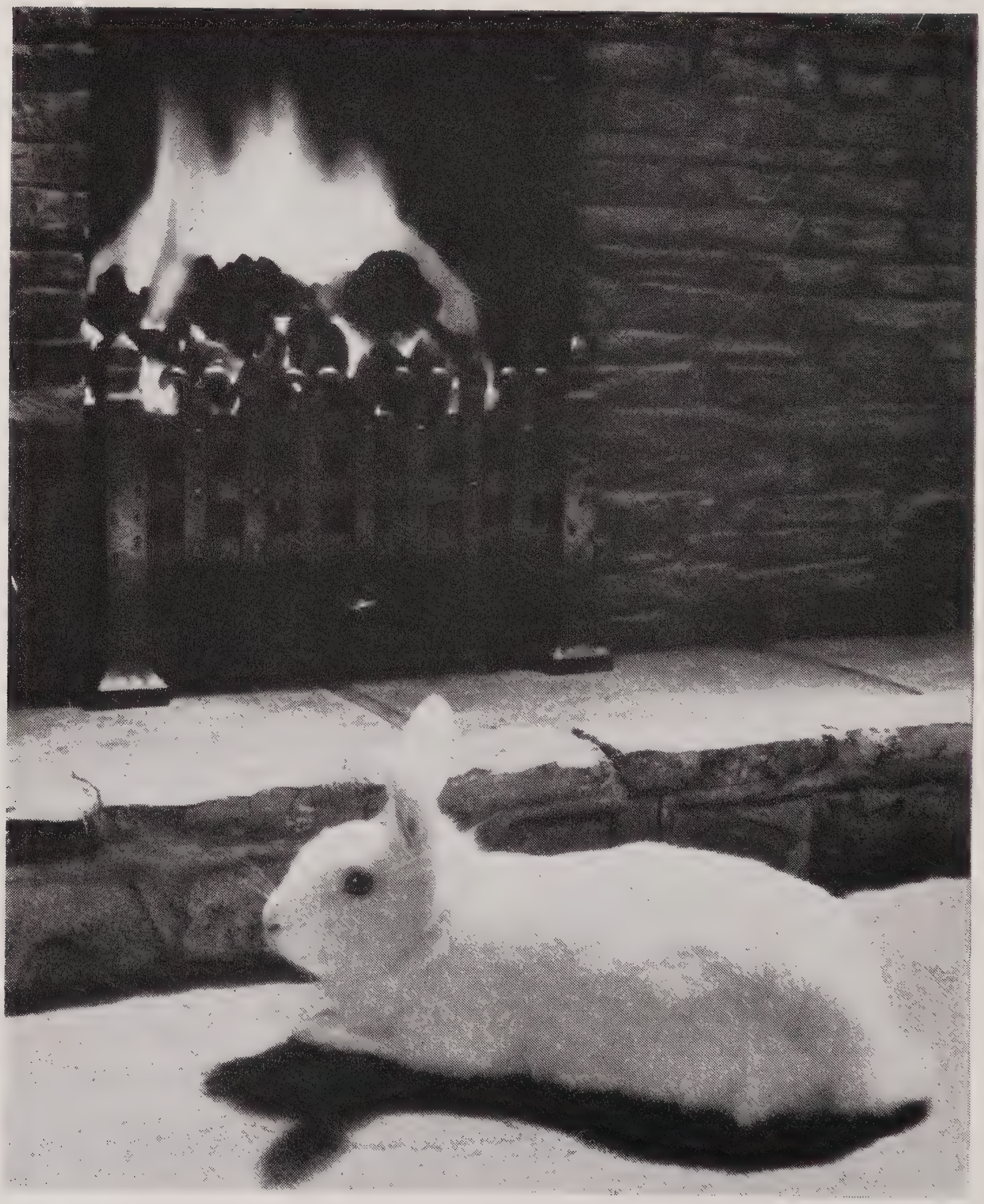
The Municipal Journal covers every aspect of local government and is read by chief officers of all departments. It regularly contains features and articles on health, hygiene and cleansing and generally contains features, news and data both administrative and technical.

(*continued*)

REXCO

SMOKELESS COAL

gives far more pure heat!



NATIONAL CARBONISING COMPANY LTD · MANSFIELD · NOTTS.

The Municipal Year Book recognized as the encyclopaedia of local government and an essential work of reference, contains full statistical data of United Kingdom local authorities.

The Group is also responsible for organizing exhibitions for the following: Association of Public Health Inspectors, National Housing and Town Planning Council, Chief Fire Officers Association/Institution of Fire Engineers, British Fire Services Association, Institute of Works and Highways Superintendents and the Federation of British Fire Organisations.

In addition, the Public Works and Municipal Services Exhibition held biennially at Olympia, London, is organized by the Municipal Agency Ltd., another company within the *Municipal Journal* Group.

A3 NATIONAL CARBONISING COMPANY LIMITED and SCOTTISH REXCO LIMITED, Fullarton Lodge, Crow Hill Drive, Mansfield, Nottinghamshire. (Telephone: Mansfield 2357-9). London Office: "Thorney House", 34 Smith Square, Westminster, London, S.W.1. (Telephone: ABBey 6086).

This year, the makers of Rexco Smokeless Fuels have designed their stand mainly to interest the local authority representatives from Scotland. The theme of the stand is "Scottish Rexco from Scottish mines for Scottish homes".

The usual lounge feature is centred around the popular "Redfyre" "60" Continuous Burning fire on which Rexco, made from Scottish coal, is blazing merrily.

This modern form of heating in a traditional setting becomes increasingly popular year by year and the makers of Rexco are constantly increasing production. The accent this year on Scotland coincides with the commissioning of the first Rexco unit to be built in Scotland, where the authorities for some time now have been demanding increased supplies of reactive smokeless fuel before agreeing to the extension of the Clean Air Zones.

A section of the stand has been devoted to showing photographs and location of the new installation; also a display of the various "Redfyre" appliances marketed by Newton Chambers and Company Limited of Sheffield.

Staff on the stand will be pleased to give information on the distribution of Rexco in Scotland and also on the whole range of Redfyre solid fuel appliances, which are suitable for use on Local Authority Housing Contracts and in Clean Air Zones generally.

Information and advice on smokeless solid fuels and appliances approved for use in Smoke Control Areas are readily available on STAND A15, or from the Fuel Technology Department of your nearest Regional Sales office of the **NATIONAL COAL BOARD.**

Stand No.

A15 **NATIONAL COAL BOARD, Hobart House, Grosvenor Place, London, S.W.1. (Telephone: BELgravia 2020).**

The National Coal Board Stand introduces "Homefire", the Board's new premium solid smokeless fuel for the open fire. Displays illustrate how this is made and visitors to the stand can see the fuel under fire. The display also shows how solid fuel can satisfy the requirements of Clean Air Legislation for industrial and commercial consumers.

D33 and D8 **NATIONAL SOCIETY FOR CLEAN AIR, Field House, Breams Buildings, London, E.C.4. (Telephone: CHAncery 5038).**

Featured on Stand No. D33 are two new "Do-It-Yourself" exhibition display kits which are available for sale to local authorities and other bodies wishing to publicize "Clean Air".

The first kit is called "Six Reasons for Smoke Control" and consists of six large photographs with six display cards containing the captions.

The second set is called "Why Clean Air For Me?" and again employs a combination of photographs and captions. This set is especially designed for local authorities proposing to make a Smoke Control Order and gives answers to householders' questions and objections to clean air zones.

On another stand (No. D8), there is a pictorial display called "The Poisons We Breathe", devised by Dr. Mary Catterall, Senior Registrar for Respiratory Diseases for the United Leeds Hospitals.

Elsewhere in the Exhibition are various displays of the Society's posters, display panels and photographs and a bookstall of Clean Air Literature and publications is located in the Conference Office.

D9 **PERGAMON PRESS LTD., Headington Hill Hall, Oxford. (Telephone: Oxford 64881).**

For full details of books on view on our stand and other Pergamon books and journals, please apply to the above address.

"Inhaled Particles and Vapours". Edited by: C. N. Davies London School of Hygiene and Tropical Medicine. Containing the 38 papers presented at the International Symposium on Inhaled Particles and Vapours held in Oxford, this work provides a unique source of information about many facets of our present knowledge on this fundamental subject. 495 pages. £5 net.

"Design and Use of Respirators". Proceedings of a Joint Meeting of the Economics Research Society and the British Occupational Hygiene Society, held at Porton.

(*continued*)

Edited by C. N. Davies, London School of Hygiene and Tropical Medicine.

The first on the subject, this book expounds the latest ideas on industrial dust masks and respirators for toxic atmospheres. Self-contained breathing apparatus for use below water, in fire fighting and for mine rescue is also discussed. 181 pages. 60s. net.

"Biological Waste Treatment". W. W. Eckenfelder and D. J. O'Connor, Associate Professor of Civil Engineering, Manhattan College.

Deals with the physical and biological principles of waste treatment and their engineering application to stream pollution analysis and waste treatment plant design. 299 pages. 65s. net.

"Industrial Electrostatic Precipitation". H. J. White, Director of Research, Research-Cottrell Inc., U.S.A.

Provides the first comprehensive account of the fundamental principles and underlying theory of the most used process for control of air pollution in heavy industry. The volume will be of direct value to engineers, scientists, and all those concerned with air pollution control, technology of gas cleaning, recovery of valuable dusts or high-quality air cleaning.

Distributed in the U.S.A. by Addison-Wesley Publishing Co. Inc. 380 pages. 94s. net.

"International Journal of Air and Water Pollution". An expansion of the International Journal of Air Pollution, this journal provides a medium for papers marking advances in the understanding of the principles involved in this wider field of work. New techniques in experimental or analytical methods, and in instrumentation are described. Monthly. Annual subscription rate: "A" £21; "B" £5 5s.

A2 **H. PICKUP LTD., Roscoe Works, Roscoe Street, Scarborough, Yorkshire. (Telephone: Scarborough 4996/8) and at York.**

Pickups will be showing illustrations of typical heating, structural steel and electrical installations carried out by them in various parts of the Country in schools, hospitals, public buildings, hotels, private residences, swimming pools. They are approved installers for all types of smokeless fuel installations.

As well as being heating and ventilating engineers, structural engineers, electrical contractors and foundrymen, they are manufacturers of "Oxypic" Sealing Compound for leaking heating installations, which is sold throughout the world; and of "Lockanlift" patent locking-and-lifting manhole covers which are standardized by many local Authorities.

The company are the official flue contractors for this Exhibition.

Stand No.

A7 **THOMAS POTTERTON LTD., Cavendish Works, 29-30 Buckhold Road, Wandsworth, London, S.W.18. (Telephone: VANdyke 7202). 85-87 Cookridge Street, Leeds,. (Telephone: Leeds 24452).**

A representative selection of the well-known Potterton gas and oil-fired boilers will be shown.

All Potterton boilers are fully automatic and, once they are properly installed, require the minimum of attention from the user. They are sectional boilers made of cast-iron, which is accepted as the best metal for boilers, because of its high heat transfer properties and its long life. Servicing of the boilers need only be normally carried out once or twice a year.

There is a Potterton boiler available for all types of installations; they range in size from 31,000-2,000,000 Btu/h. In the domestic range of gas-fired boilers both small bore and room sealed models are available and Thomas Potterton Limited also market a gas-fired warm air circulator which has an output of 35,000 Btu/h. Radiators, with a guaranteed heat emission rate per sq. ft., are the latest addition to the range of Potterton products.

Potterton boilers are supplied as complete units with all controls matched and tested. They make no dust, smoke or ash and are suitable for use in areas covered by the Clean Air Act.

Full details of the boilers, as well as advice and information on heating can be obtained on the stand.

D12 **PYRAMID PRESS LTD., Publicity House, 41 Streatham Hill, London, S.W.2. (Telephone: TULse Hill 1222 (9 lines)).**

The publications to be found on our book stand were produced free of all cost for various local authorities and they deal particularly with Clean Air Zones.

The publications are designed to be used by Public Health Inspectors when they are conducting their clean air campaigns and they are both informative and interesting to members of the public.

Our representative at the stand will be able to assist you in any queries you have regarding these publications.

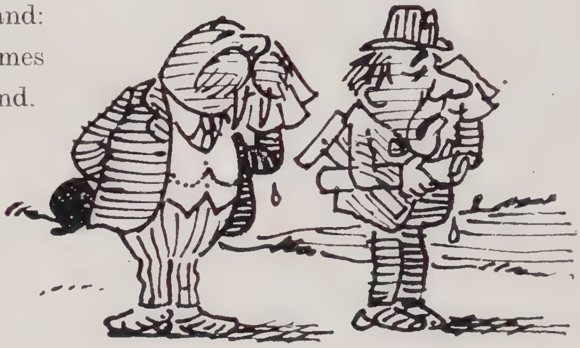
D18 **RADIATION GROUP, Radiation House, North Circular Road, London, N.W.10. (Telephone: WILlesden 1234).**

Appliances for room heating, central heating and water heating by gas and by solid fuel are shown by the Radiation Group.

Solid Fuel.—Of particular interest in the context of clean air are the solid fuel appliances, including the well-known "open fire behind glass" room and water heaters, the "Parkray 33" for room heating only, the "66" for room heating, domestic hot water and a

The Council and their Architect...

. . . Were walking close at hand;
They wept like anything to see
Such tracts of council land:
'If only we could build some homes
To do our council grand.



'If seven homes on seven plots
Were built in half a year,
Do you suppose,' the Council said,
'We'd make our tenants cheer?'
'I doubt it,' said the Architect,
'Unless a Parkray's there.'

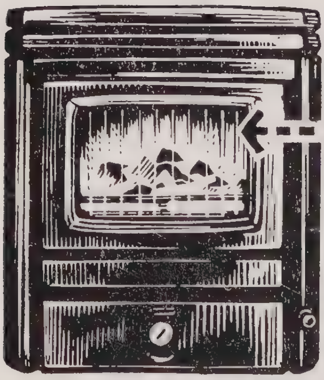
'The time has come,' the Council said,
'To talk of many things:
Of homes with warmth and central heat
(In fact what Parkray brings)
And where the water's boiling hot
Where heating has no strings.'

'An open fire,' the Council said,
'Is what we chiefly need;
Rads, towel rail, hot water too
Are very good indeed,
And as the Parkray's all enclosed,
Control is guaranteed!'

'The 77's what we want,'
The Architect did beseech.
'The cosy fire burns smokeless fuel,
The cost's within our reach.
Heats rads as well in other rooms,
It really is a peach.'

'If we could build with careful thought,
Homes that have all you've said,
Do you suppose,' the council mused,
'We'd end up in the red?'
'I doubt it,' said the architect,
With Parkray in his head.

Parkray



open fire behind glass

PARKRAY 77
It looks and feels like an open fire yet it has the greater efficiency of a totally enclosed appliance. It will effectively heat a room of up to 1800 cu. ft, plus 50 sq. ft. of radiating surface, plus all the hot water. Without hot water up to 80 sq. ft. of radiating surface.

PARKRAY 66
This smaller boiler version of the Parkray 77 heats all the hot water and a towel rail—*or* two radiators.

PARKRAY 16
Open fire high output boiler flue set which can be used to run a five radiator system or 2/3 radiators plus hot water and a towel rail.

RADIATION
PRODUCTS

RADIATION PARKRAY LIMITED, RADIATION HOUSE, NORTH CIRCULAR ROAD, LONDON, NW10

radiator or towel rail, and the latest, the "77" with high output back boiler capable of serving a central heating system for four or five radiators in addition to its room heating duty.

Parkray independent boilers include the "S25", a compact boiler of 15,000 Btu/h output, and the "S56" hopper feed boiler for burning coke, which will supply domestic hot water and heat five or six radiators (up to 115 sq. ft.) if used for central heating only. One of the outstanding features of the "S56" is its capacity to maintain an average output for 24 hours on one charge of fuel.

For Clean Air Zone replacements there is a sustained demand for a low cost smokeless fuel inset fire. The "Parkray 16" Clean Air fire was specially designed for this requirement, its one-piece enamelled front simplifying colour stocking.

Gas room heaters shown include the Bratt Colbran "Crystalglow", the first glass fronted gas fire, which brings into the home efficiencies previously obtained only in the laboratory. Another exhibit is the Bratt Colbran "TEN", a low-cost heater adaptable without any extra parts for fireplaces with 22 in. overhanging frieze, or 24 in. high opening. It can also be wall-mounted.

Gas fired central heating is shown in two forms. The "Ductair" range of fanned warm air heaters is represented by the popular "G105-23". The "Parkray" small bore units are exemplified by the remarkably compact "G301-2", which can be installed on the wall, in a kitchen cabinet, or even under the stairs; it has the ability to sense whether hot water demands are for hot water taps or for central heating and to select its rate of gas burning accordingly. The "G301-2" will serve three or four radiators (100 sq. ft.) as well as domestic hot water supply; "G301-1" for central heating only will heat up to six radiators (125 sq. ft.). Larger output models of both "Ductair" warm air and "Parkray" small-bore appliances are available.

D26 and D27 **REVO ELECTRIC COMPANY LTD., Tipton, Staffordshire. (Telephone: Tipton 2828).**

A major breakthrough in the field of electrical central heating has been made by the Revo Electric Co. Limited, who are launching a new type of storage heater which has a controlled output that enables a uniform room temperature to be maintained whilst using a much smaller-capacity heater. In this new unit, the core is charged at the lower tariff rate during the night and the stored warmth is circulated by means of a thermostatically controlled fan during the day.

With this thermostatic control, the room is maintained at a uniform temperature whereas with other types of storage heater, there can be a tendency for the room to be unnecessarily hot around midday with uncomfortably low evening temperatures.

(*continued*)

CUT

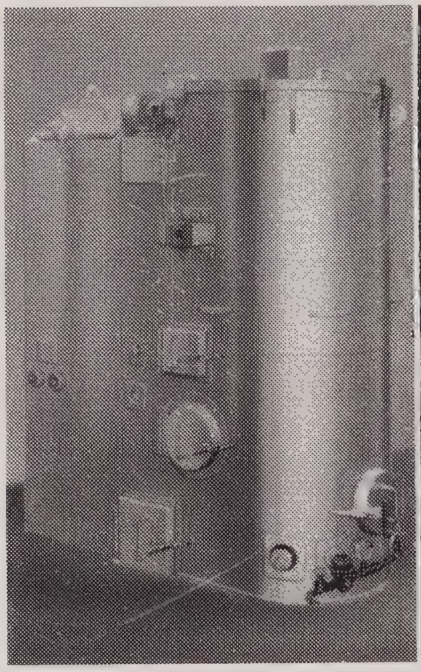
YOUR HEATING COSTS
BY HALF—OR MORE!

cut £p cut £p

Do fuel bills worry you? Are you affected by Smokeless Zone regulations? Is your present boiler proving unsatisfactory, inefficient, uneconomical? Are you thinking of installing a boiler?

Then this new boiler has proved to be the lowest in cost and the provision of useful heat to-date. The new Stempo boiler -based on an entirely new approach to fuel, utilisation and combustion - is the answer, it reduces fuel bills to less than 6d. per therm of useful heat and is cheaper in capital and running costs than alternative methods.

VISIT
STAND
B 10



✻ USES CHEAPEST FUELS
UP TO 50 THERMS PER £1
✻ FULLY AUTOMATIC
NEEDS NO ATTENTION
✻ FULLY PACKAGED
LOWER INSTALLATION COSTS
✻ SMOKELESS
IDEAL FOR SMOKELESS ZONES
✻ 90% EFFICIENCY

STEMPO

SMOKELESS
HIGH EFFICIENCY
BOILERS

ROBERTS BROS. (AUDNAM) LTD.
METEOR WORKS, JUNCTION ROAD, WORDSLEY, NR. STOURBRIDGE, WORCS.
TEL. STOURBRIDGE 3101

Although the new units are slightly more expensive than other types, the actual cost of heating a house by the new system will be less and running costs will be considerably less.

The Revo system has all the advantages of electricity—no boiler house, fuel store or maintenance and simplicity and absence of mess during installation.

Prices of the Revo range of thermal storage heaters vary from £41 13s. Full details and advice on installation are available from any electrical retailer or Electricity Board.

D28 RILEY (IC) PRODUCTS LIMITED, 19 Woburn Place, London, W.C.1. (Telephone: TERminus 2622).

The display areas illustrate the products of Riley (IC) Products Limited, applicable to clean air, fuel efficiency and domestic heating.

Particular reference is made to the Gaserator and Riley-Pillat gas and oil-fired incinerators for the efficient, safe and hygienic disposal of hospital and industrial waste without smoke emission.

The range of Riley mechanical stokers burn cheap bituminous and industrial slack coals with economy and maximum output from the boilers.

Riley automatic pressure jet oil burners with fuel consumptions ranging from five to 1,000 lb. per hour are widely used for firing boilers and heat receivers in private residences and industries.

Riley incinerators, stokers and oil burners provide reliable, efficient combustion and comply with the most stringent requirements for clean air.

B10 ROBERTS BROS. (AUDNAM) LTD., Meteor Works, Junction Road, Wordsley, near Stourbridge, Worcestershire. (Telephone: Stourbridge 3101-4).

The improved combustion process included in Stempo Boilers facilitates utilization of ordinary bituminous coal for smokeless combustion. The combustion air preheated by waste gases in a specially designed air heater utilizing the waste products of combustion operates at an efficiency of over 85 per cent, resulting in lowest fuel cost obtainable to date. The boilers can be used for production of hot water or steam and are fully automatic in operation including the fuel delivery and ash extraction.

The boilers are packaged and include a 24 hour fuel storage hopper and approximately one week's ash storage space. Automatic fuel feed of the boiler hopper and automatic ash extraction from ash storage space can also be arranged. The vertical arrangement of heating surfaces, fire tubes and smoke tubes and the additional heating surface provided renders high availability of the boiler. The maintenance costs are also very low because the boilers do not need to be cleaned any more than at two-monthly intervals, and any parts which may be subject to wear are made robust from the best materials.

The boilers can utilize any type of solid fuel up to 1½ in. size but of course are most economical when utilizing cleaned bituminous fuel such as washed smalls, peas, beans or singles. The boilers are provided with forced and induced draught fans, dampers automatically controlled to maintain both combustion chambers and flue passes under suction so that any possible leakages cause infiltration of clean air into the boiler instead of smoke pollution of the boiler house. Only a minimum length of chimney acceptable to the health authorities is required as all necessary suction is provided in the induced draught fan.

Fully automatic and smokeless operation can be achieved from 100 per cent to five per cent load without any danger of excessive corrosion due to flue gas temperature falling below dew point. Over 80 per cent efficiency on continuous automatic operation and 85 per cent efficiency at any set load between 40 per cent and 100 per cent rating is guaranteed.

A pilot flame equivalent to less than five per cent load can be maintained indefinitely simply by switching the master controller normally or automatically to "Rekindle" for automatic lighting up. Hand firing of the boiler can be arranged for customers who do not want to lose heat in case of a power cut which would render the automatic operation ineffective.

All boilers are fully welded and insurance company tested prior to despatch, manufactured to B.S.S.855 or B.S.S.2790 whichever may apply.

The standard finish of the boilers is two coats of aluminium paint or hammered enamel in blue, green, grey or brass. Delivery: two to three months.

The units now available range from 200,000 Btu/hr. to 3,000,000 Btu/hr., 500 lb. of steam/hr. to 3,000 lb. of steam/hr. The floor space required ranges from 2 ft. 6 in. by 5 ft. to 4 ft. 6 in. by 9 ft., according to size and including the 24 hour fuel storage and seven days ash storage.

D3 and D4 **ROBINSON & NEWBERY LTD., 22 Stuart Crescent, Wood Green, London, N.22. (Telephone: BOWes Park 3312).**

The new " Ozonomat " range of air purifiers will be demonstrated.

D6 **SANIGUARD APPLIANCES LTD., Fowler Road, Hainault, Essex. (Telephone: Hainault 4111-2-3).**

The Barrywald Safety Sanitary Incinerator has now been displayed at all of the Public Works and Municipal Services Congresses and Exhibitions since the war in its various forms and has won high acclaim from many thousands of different establishments for the improvements in hygiene achieved for its intended purpose.

Newest developments have produced a higher rate of disposal for a lesser running cost thus making this appliance more attractive from every point of view.

The electrical loading is now set at 1kW. and all components are fully guaranteed for one year and the appliance is backed up by a fully confident service organization which can carry out its efficient activity in all parts of the country.

The size of the Barrywald Incinerator is now 19 in. by 18 in. by 10 in. and its weight is approximately 50 lb. For new applications and advice regarding the installation, which is a simple matter under normal circumstances, please enquire at our stand.

Also on display will be Eldorite Mineral Wool insulation material.

D14 **SHAW & SONS LTD., 7 Fetter Lane, London, E.C.4. (Telephone: FLEet Street 8171).**

Publishers since 1750. Specimen forms and records under the Clean Air Act, 1956, on display.

B11 to B13 **SHELL-MEX AND B.P. LTD., Shell-Mex House, Strand, London, W.C.2. (Telephone: TEMple Bar 1234).**

Recently the Ministry of Housing and Local Government and the Scottish Development Department issued a memorandum on chimney heights, and this together with other relevant documents forms part of the theme of the Shell-Mex and B.P. stand.

Also the stand shows examples of recent developments in the field of oil-fired domestic heating with particular emphasis on the less expensive methods of household heating where, for reasons of smoke control legislation, the existing ways of heating must be changed.

In addition to these examples of current progress attention is drawn to the Company's planned delivery service for Domestic Fuel Oils. This is a country-wide service devised to ensure adequate supplies to domestic users at all times.

B4 **SMITH, BELL AND CO. (LONDON) LTD., Marlon House, 71-74 Mark Lane, London, E.C.3. (Telephone: ROYal 1346-7-8).**

Air Conditioners/Heat Pumps.—A complete range of Wright air conditioners/heat pumps is available with capacities from 24,000 Btu. to 240,000 Btu., either as packaged or remote units. The main advantage of the heat pump is that it offers combustionless heat, provides cooling, constant temperature automatically throughout the year, easy installation, complete air filtration, and most important a performance energy ratio that can be as much as 3.1.e. the heat pump is capable of delivering three times as much heat as the equivalent of the electrical energy consumed. (*continued*)

Stand No.

Bell-Air Conditioners.—These units have a year-round use for cooling in the summer and acting as humidifiers in the winter. The "Amer-Glas" filter removes particles in the atmosphere down to five microns. The activated charcoal filter absorbs odours and the unit is completely free standing creating no installation problems whatsoever.

These units are suitable for homes, boardrooms, offices, waiting rooms, hospitals and clinics, restaurants, kitchens, public houses, clubs, studios, lecture rooms and workshops.

"Morwennair" Table Fan Heaters.—Available in three sizes these attractively styled revolving tables with built-in fan heaters are revolutionary in as much as they contain two-stage 2 kW. heater with two-speed tangential flow fan, they are thermostatically controlled with an automatic safety cut-out. A socket outlet is provided in the side of the table which is ideal for connecting TV set, bedside lamp, electric blanket, coffee percolater, etc. A neon pilot light indicates when unit is in operation.

"Morwennair" "365" Portable Air Conditioner.—For offices, hotels, etc. The unit contains 1/6th h.p. refrigeration system giving 10/15°F temperature drop and $\frac{1}{2}$ kW. heating for a cool day. The tangential fans make the unit particularly quiet. A skeleton unit is available for building into office, hotel, and exhibition furniture, and can be installed most unobtrusively.

B2 **SOLID SMOKELESS FUELS FEDERATION, 74 Grosvenor Street, London, W.1. (Telephone: MAYfair 3327-8).**

The Federation's stand has two purposes this year, one to display a range of efficient solid fuel burning appliances suitable for burning the fuels in plentiful supply throughout the country. These will be an under-floor draught open fire, an inset room heater and a free-standing room heater and all these appliances will be working. There will be a comprehensive fuel display and a section dealing with clean air in general.

The second purpose will be to demonstrate the equipment being used on the stand; this is part of a new exhibition unit designed by the Federation for erection in halls or marquees to demonstrate solid smokeless fuels and solid fuel appliances. This equipment is simple to erect and completely self contained. It is erected and staffed by the Federation's own employees and offered on loan to local authorities for use in their own exhibitions.

Additional sections can be added to the display to demonstrate household improvements and conversions or central heating.

Enquiries will be welcomed about the exhibition, its erection, dismantling and operation.

Stand No.

D29 THERMODARE (GREAT BRITAIN) LTD., St. Margaret's House, 57 Victoria Street, London, S.W.1. (Telephone: ABBey 6586-7-8).

Thermodare (Great Britain) are exhibiting a comprehensive range of domestic night storage heaters which utilize the cheap "off-peak" tariffs available from all electricity boards for central heating in the home.

Thermodare were the first to produce this type of heater and after many years of experience in the industrial storage heater field, were the first to offer a range of domestic models. It is indeed in the light of this experience that Thermodare have maintained the policy of a factory built and tested heater which is supplied ready for immediate connection. In this way you avoid all the inconvenience, dirt and mess associated with heaters which are assembled in the home, with the certain knowledge that each heater has been subjected to a full day's running prior to leaving the works. All models are equipped with a five position thermostat switch which enables them to be regulated appropriate to seasonal weather variations and is further protected by a fusible safety link. This unique safety factor affords complete protection and eliminates any fire risk.

The four domestic models in the Thermodare range of night storage heaters, are:

(*a*) The DV.25 rated at 2½ kW, priced at £21 10s. 0d. free of purchase tax, with the alternative

(*b*) DH.25 likewise rated at 2½ kW, but suitably dimensioned for siting under low windows and similar positions, priced at £23, free of purchase tax.

(*c*) The D.15 rated at 1½ kW is priced at £19 9s. 0d., free of purchase tax and is mainly used for the smaller type of room.

(*d*) The DFA.25 rated at 2½ kW is the latest model which has been developed to meet the two-fold requirements of:

  (i) a continuous daytime output to maintain background warmth, and

  (ii) facility to boost the room temperature by switching on the fan which provides an additional flow of warm air when normally required, say from 6 p.m. onwards. (£35 13s. 6d., free of purchase tax).

A21 JOHN THOMPSON (Wolverhampton) LTD., Ettingshall, Wolverhampton, Staffordshire. (Telephone: Bilston 41121)

The John Thompson Group of Companies, leading manufacturers of steam raising plant and all ancillary equipment, are illustrating the equipment they manufacture for the efficient combustion of low grade fuels in full compliance with the Clean Air Act.

(*continued*)

TILGHMAN'S
LIMITED

FOR AIR FILTRATION AND DUST COLLECTION

- ELECTROSTATIC PRECIPITATORS
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- "AQUASPRAY" WET TYPE DUST COLLECTORS
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Specialists in HIGH EFFICIENCY AIR and GAS filtration with Technical Engineers available at five main centres in Great Britain to advise on the selection of the most suitable equipment to overcome your problem.

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PRODUCTS

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Dust & Fume Control Division
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LONDON OFFICE: 1 CHESTER STREET, S.W.1

STAVELEY SG GROUP

T591

As a subsidiary of the Group, John Thompson (Triumph Stoker) Ltd. manufacture a full range of mechanical stokers for firing all sizes of shell and sectional boilers.

Photographic panels are used to depict:-

The "Ministoker"—which has been evolved to meet the needs of the smaller steam user with a small shell or sectional boiler to fire. It will burn low grade fuels, smokelessly and with Maximum Combustion Efficiency. It is almost fully automatic and requires a minimum of maintenance. It is robust in construction and simple in operation.

The Thompson Triumph "Travelling Grate Stoker"—for larger Shell Boilers has a wide application. Photographs of several interesting installations, including a hospital, a textile works and a modern factory are displayed.

The 3 Pass Rear Ashing Wetback Boiler—manufactured by John Thompson (Wolverhampton) Ltd., which is fired with a Triumph Ministoker, is a new concept of cleanliness in coal-fired operation.

The fuel is handled cleanly, burned cleanly, without smoke, and disposed of cleanly, without dust.

In a cutaway view, the two passes of smoke tubes, the full length corrugated flue and the all-welded construction are clearly seen.

John Thompson representatives are at your service at all times to advise on any problems in connection with steam raising with particular reference to clean efficient results.

A18 and A19 **TILGHMAN'S LTD., Broadheath, Altrincham, Cheshire. (Telephone: Altrincham 4242 (9 lines)).**

The Dust and Fume Control Division will be exhibiting their wide range of high efficiency air filtration and gas cleaning plant and equipment.

Working demonstration units of the Tilghman ultrafiltration air filter and TH electrostatic air filter will be on show. These types of air filters are being used to produce super clean air for applications such as ventilating systems in hospitals, office blocks, stores, laboratories, electrical control rooms, sewage plants, computor and telephone apparatus rooms and clean air assembly plants, etc.

Electrostatic precipitator dust collectors for gas cleaning are the new addition to Tilghman's range of products and full details will be available for the first time at any exhibition.

(*continued*)

Stand No.

A demonstration automatic fabric filter unit will also be on show demonstrating the principle of operation of these units which are now widely used in the chemical, rubber, metallurgical and steel industries for high and low temperature dust collector applications.

Photographs of recent installations will be exhibited, particularly relating to the 42 arc furnace fume control plants, cupola gas cleaning and the high temperature fabric filters which form the large export orders received for this equipment during the current year including repeat orders from Russia value approximately £400,000.

D10 UNITED STATES DEPARTMENT OF HEALTH, EDUCATION AND WELFARE, Public Health Service, Division of Air Pollution, Washington, 25, D.C., U.S.A.

A selection of pamphlets and literature produced by the Department will be on display. These include booklets based on speeches presented before the Air Pollution Control Association and at the National Conference on Air Pollution.

Reserve your space **NOW** *for the*

1964 NATIONAL CLEAN AIR EXHIBITION

Harrogate — October 20-23

Plan and details in Exhibition Organizer's Office in the Spa Ballroom

VISUAL AIDS FOR LECTURERS AND TEACHERS

COLOUR FILMSTRIPS

WITH AUTHORITATIVE DETAILED NOTES

AIR POLLUTION
by **Professor R. S. Scorer**
Part A. *DW-F22* Nature, Production and Effects of Air Pollution
Part B. *DW-F23* Dispersion and Accumulation of Air Pollution; Behaviour and Appearance of Smoke.

CHRONIC BRONCHITIS
DW-F28 by **Dr. J. L. Burn,** Chairman, National Society for Clean Air.

These three colour filmstrips are in 35mm x 24mm picture size and may be cut up and used as slides

Each strip, with notes, price £2

Produced and distributed by: DIANA WYLLIE LTD., 3 Park Road, Baker Street, London, N.W.1

DRAUGHT-PROOF VENTILATION—the KEY TO CLEAN AIR

**FUEL
COMBUSTION
PROBLEMS
are mainly due to
AIR STARVATION
in Rooms and Flues**

**The IMPROVED
Draught-Master
is IDEAL for HOMES
with SOLID FLOORS
RETAIL PRICE 35/-**

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Automatic HALL TO ROOM one way inlet at ceiling level
(As advised by the Coal Utilisation Council)

**The DRAUGHT-MASTER Automatic Air Inlet
solves the problems of
AIR STARVATION in ROOMS and FLUES
(the prime cause of SMOKY FIRES and CROSS ROOM DRAUGHTS)**

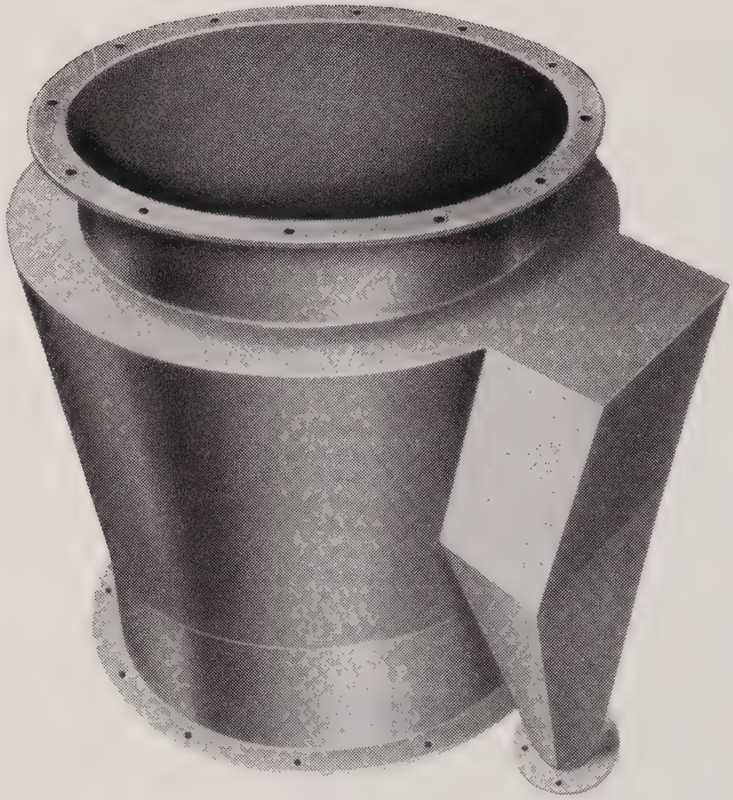
EXTRACT FROM RECENT TESTIMONIAL.
ECCLES, MANCHESTER. APRIL, '62

"*. . . I must say this (the DRAUGHT-MASTER) is all you CLAIM. My house has never, ever been so smoke and dirt free, and I have lived in it for 25 years . . .*"

The importance of acceptable ventilation cannot be overstressed

Patentees and Manufacturers:

**W. G. PARSONS & SONS (Heating Engineers)
24 Barbara Close, Rochford, Essex Tel. Southend 544345**



CLEAR THE AIR WITH A

SIROCCO CHIMNEY GRIT COLLECTOR

Designed to combine optimum efficiency with low cost and minimum maintenance the Sirocco Chimney Grit Collector provides an ideal means of eliminating grit and removing a high percentage of dust emitted by small solid fuel-fired boilers, kilns and incinerators, in accordance with the statutory Clean Air Regulations. It can, in addition, be employed effectively to arrest unburned carbon smuts from oil-fired boilers, and will also serve as an efficient spark arrester.

EFFICIENCY

The "Sirocco" Chimney Grit Collector is produced in six sizes, ranging from 15″ to 30″ diameter. Two types are available: High Efficiency (H.E.) for chimneys where mechanical draught is employed, and Low Resistance (L.R.) for natural draught installations. In the removal of grit (particles over 76 microns) the H.E. Collector has an efficiency of 92 % and the L.R. type an efficiency of 87 %. The Collectors will also remove a high proportion of the finer dust, giving overall efficiencies of up to 81 % (H.E.) and up to 72 % L.R. on solids for a coarse stoker fired dust.

RELIABILITY

The greatest possible simplicity consistent with high performance has been achieved in the design of the unit. There are no moving parts and once installed this robustly constructed Collector will perform its duties over a long period.

COMBINED FAN AND GRIT COLLECTOR UNIT

In cases where it is desired to supplement natural draught to permit the installation of the high efficiency type Grit Collector, a Sirocco bifurcated axial flow fan can be supplied with the Collector, the two being combined in a single unit.

Please write for Publication Ref. 518/63 containing full details

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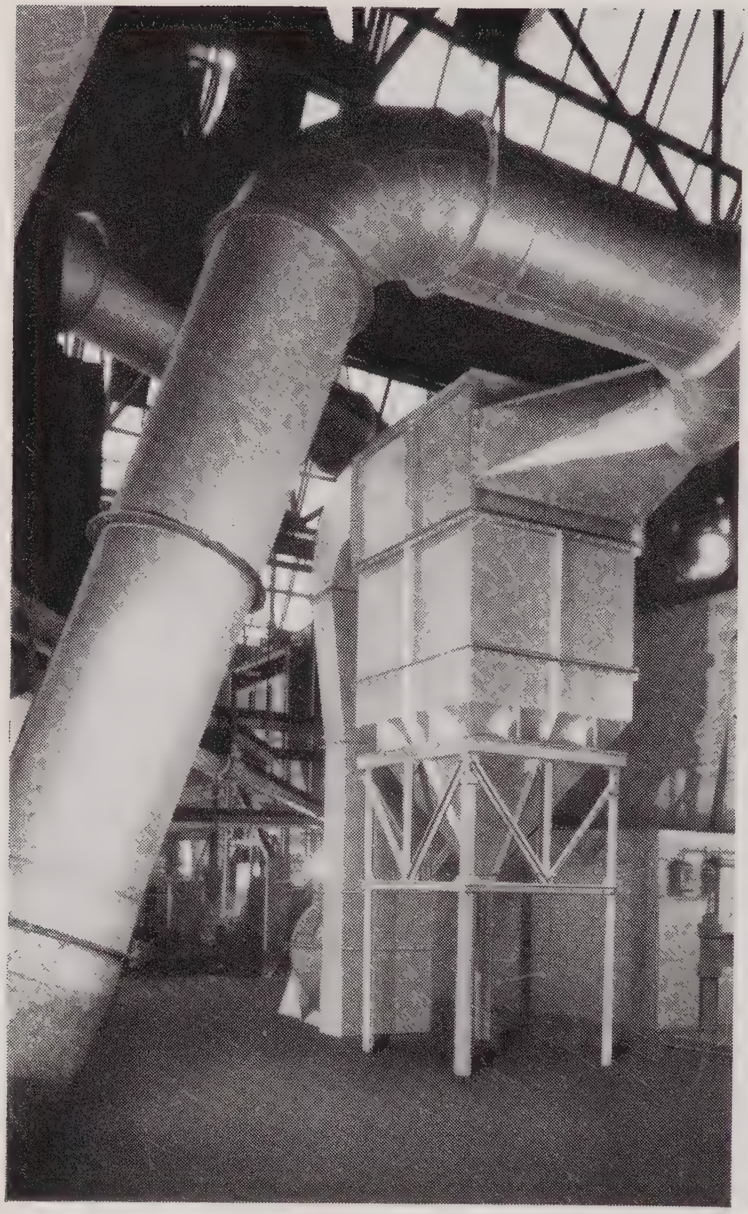

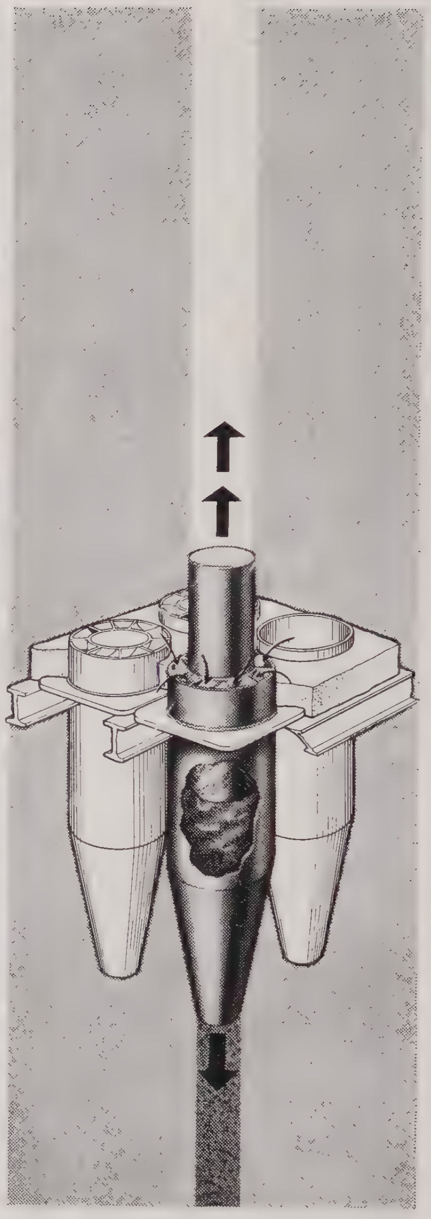

Holmes-Rothemuhle Multi-Cell Cyclone Dust Collectors

The photograph shows the Holmes-Rothemuhle Multi-Cell Cyclone Dust Collector installed at the Derby Works of Ley's Malleable Castings Co. Ltd. This unit, which cleans gases from a P.F. fired melting furnace after they have passed through a waste heat boiler, has operated at a constant efficiency of over 80% since it was installed almost three years ago. A second installation was completed almost two years ago and a third is under construction.

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E326

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A Comprehensive
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COMBUSTION DIVISION

Edwin Danks Modern Economic Boilers (High Velocity Double Pass, Treble Pass, Thermal Storage and Wet Back) fired by the new 'Airspin' Turbine-Driven Rotary Cup Oil Burner *or* the universally known Oldbury Chain Grate Stoker.
Edwin Danks New 'Airspin' Oil Burner and the Oldbury Stoker were specifically designed for shell-type boilers.

OLDBURY, NEAR BIRMINGHAM
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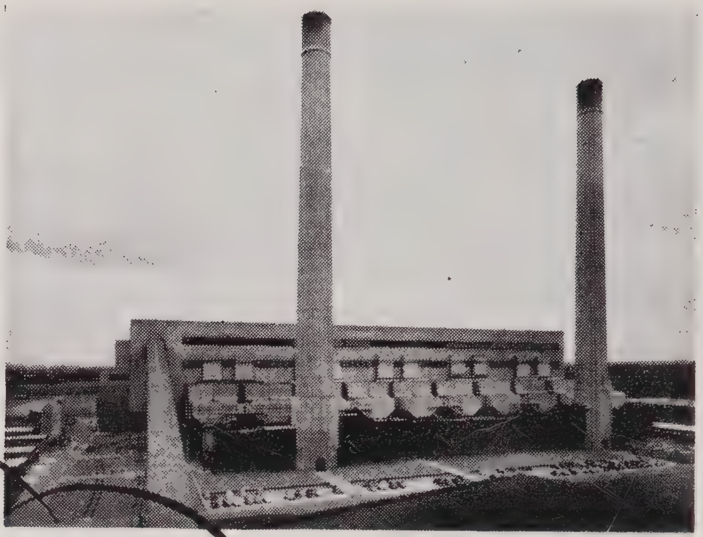

High Marnham Power Station where 20 Sturtevant Electrostatic Precipitators are installed.

Sturtevant

CLEAN AIR

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ELECTROSTATIC PRECIPITATORS	The most efficient means of preventing dust and fume emission from stacks and industrial processes.
SCRUBBERS	For arresting all types of dust–particularly those of an explosive or inflammable nature.
MECHANICAL DUST COLLECTORS	For extracting dust from gases at high efficiency over a wide range of operating conditions.
CYCLONES	For collecting a wide range of dusts of relatively coarse sizes.
TEXTILE FILTERS	For the collection of fine dusts.
AIR FILTERS	All types are employed including Electrostatic, Paper and Viscous for cleaning the air supply to air conditioning, heating and ventilating systems.

Sturtevant engineers are ready to collaborate in applying this range of plant to meet specified requirements. For details of individual subjects write to our reference Z.101/M.

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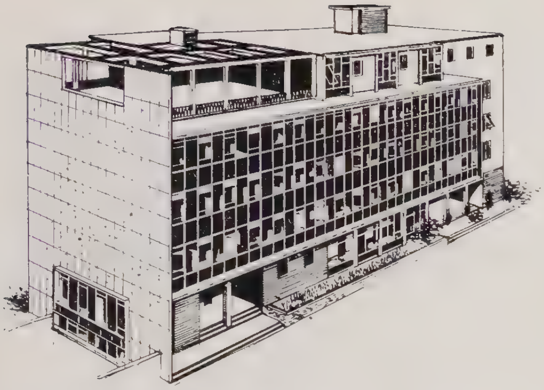


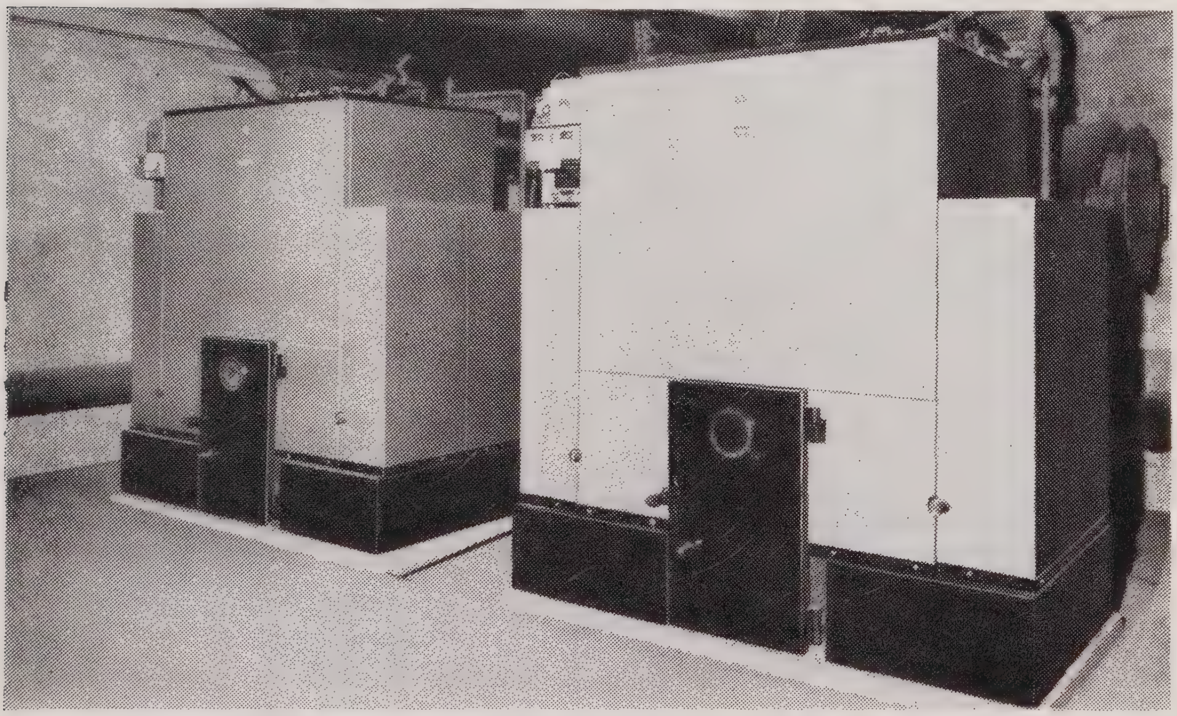
CONTROL TO CLOSE LIMITS

By Solid Fuel Trianco Boilers

The versatility and economy of Solid Fuel when used in a Trianco automatic boiler is well demonstrated in this Trianco installation at Wakefield Technical College.

Two D.1000 boilers capacity 2 million B.th.Us per hour are used in a fully automatically controlled system involving three types of heating (1) by radiators (2) by fan convectors (3) by a Plenum system. All three call for very careful temperature control within very close limits, which the Trianco boiler is designed to provide. The boilers operate at 80% efficiency with minimum labour costs.

Consulting Engineers to the Wakefield Technical College: Hoare Lea & Ptns., Manchester. Heating Engineers: W. A. Church & Sons, Wakefield.



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THE QUEEN MOTHER
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Trianco Ltd East Molesey Surrey

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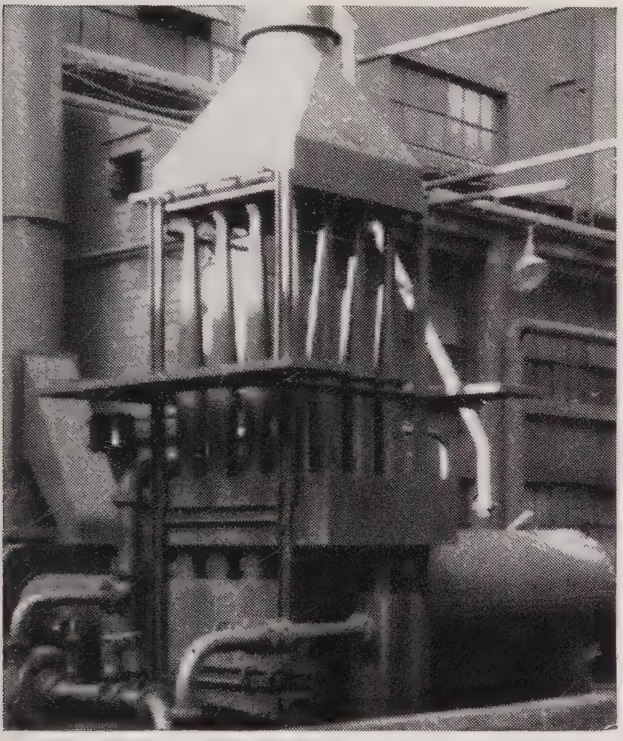

A Pontifex Wet Scrubber in use on the Coal Preparation Plant at the works of British Copper Refiners Ltd.

The most economical method of preventing atmospheric pollution or recovering valuable material involving the treatment of dust, fumes or vapours—which because of their nature cannot be recovered by Fabric Filtration—is the Pontifex Wet Scrubber. Of all-British design, it provides troublefree, high efficiency operation at reasonable cost.

Unit construction makes it necessary only to connect water, gas and electricity to make the plant ready for immediate use. In addition, as it is normally arranged vertically, minimum ground space is required.

Our free technical advisory service is always at your disposal and, to satisfy yourself that the Pontifex Wet Scrubber will handle *your* problem efficiently and economically, a pilot plant is available on loan at short notice.

If you have a problem of dust, fume or vapour recovery, be assured Frederick Jukes Limited can find the answer. Why not drop us a line or ring DERwent 2282.

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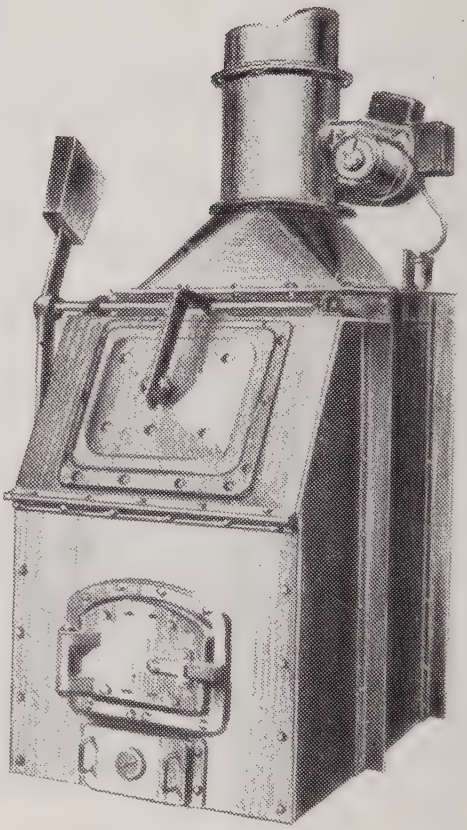

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THE REQUIREMENTS
OF THE
CLEAN AIR ACT ?

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With smoke eliminator

HYGIENIC - ECONOMICAL - models available for all kinds of general service. Special designs to meet particular purposes. We have over 60 years of background in this field.

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and the Seventh National

CLEAN AIR,
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DOMESTIC HEATING
EXHIBITION

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26th - 29th OCTOBER, 1965
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The 32nd ANNUAL
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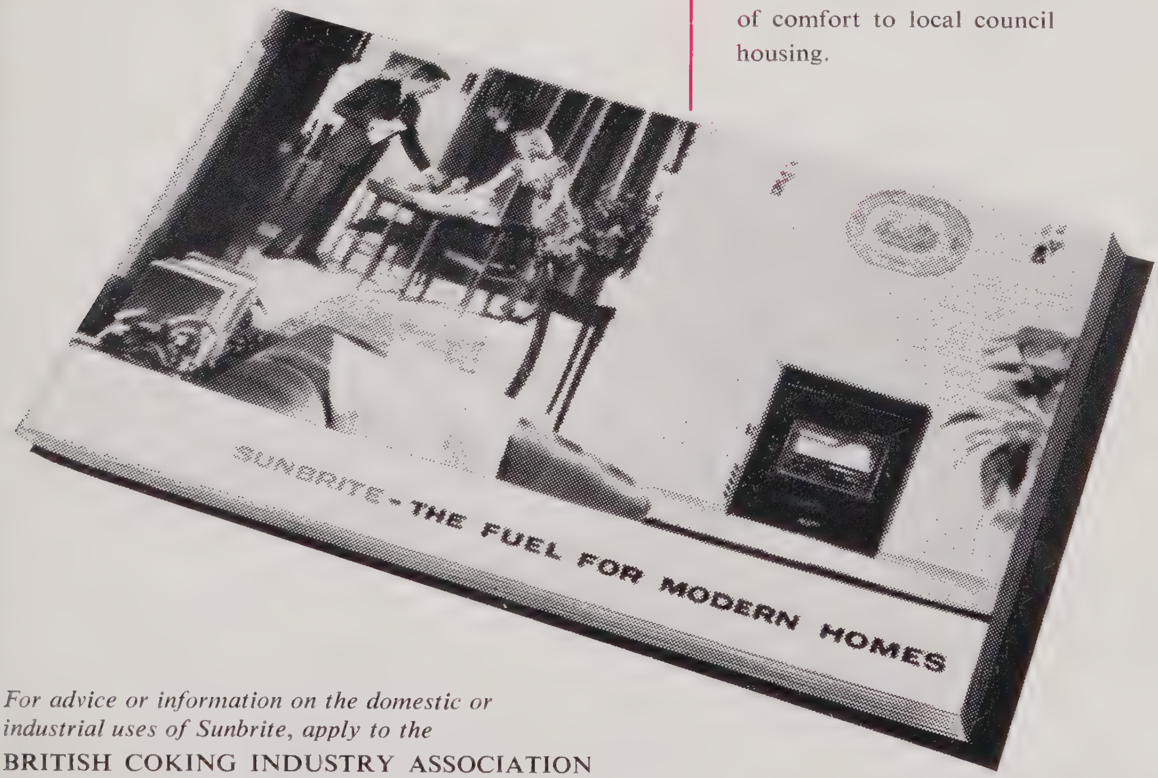

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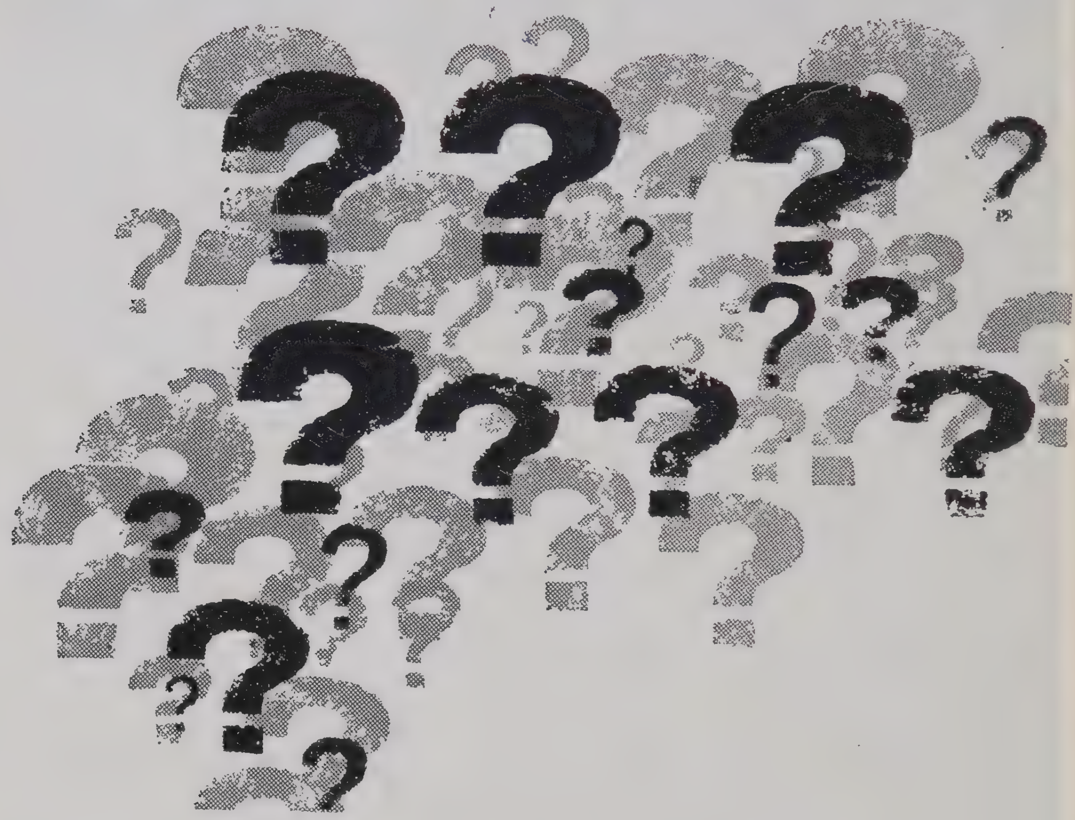

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HARROGATE

20-23 OCTOBER

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NATIONAL SOCIETY FOR CLEAN AIR

Proceedings of the 31st Annual Conference Harrogate

20th to 23rd October, 1964

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SUMMARY OF EVENTS

THE 31st Annual Conference of the Society was held in the Royal Hall, Harrogate from October 20 to 23. A total of 1,024 members and delegates attended and this number included welcome visitors from France, Germany and Holland.

In his Civic Welcome to delegates on the morning of October 20, the Mayor or Harrogate, Councillor H. S. Hitchen, compared the struggle for clean air with other campaigns for social reform that have characterized the last 100 years of history in this country. His speech showed an understanding of the complex nature of air pollution while at the same time emphasizing the paramount need to intensify the effort to complete the establishment of smokeless zones. In conclusion Councillor H. S. Hitchen reminded delegates of the unnecessary suffering and health hazards assailing the community because of reluctance and lethargy born of ignorance. He called on the delegates to leave Harrogate with a newly-dedicated zeal to achieve the goal of a smokeless Britain.

The opening address was then given by the Rt. Hon. Lord Sherfield, until recently Chairman of the Atomic Energy Authority, who introduced himself as one possessed of no kind of expertise in the clean air field but, like every other thoughtful member of the public, a warm supporter of the objectives of the Society. He applauded the action of the Society in connection with pollution from road vehicles and emphasized the need to urge the Ministry of Transport not to weary in well-doing until the problem was resolved. The bulk of Lord Sherfield's address was devoted to the origins, development and future of atomic energy as a fuel. It contained a succinct reference to the attendant hazards—anyone, who regularly eats two brazil nuts a day will exceed the yearly intake of a radio active material Radon 226 prescribed by the International Commission—and concluded with the message, "If you want to have cheap power with clean air, go nuclear".

Dr. Albert Parker, C.B.E., then delivered his second presidential address and the platform party, led by the Mayor, processed to the Exhibition Hall to declare open the largest Clean Air, Fuel Efficiency and Domestic Heating Exhibition in the Society's history.

The afternoon session that followed was devoted to a consideration of progress and planning in Smoke Control Areas from the viewpoint of the Divisions of the Society. Mr. E. J. Winfield compounded a summary of the papers submitted by Scotland, the North West, North East, Yorkshire, West Midlands, East Midlands, South West and the South East Divisions. It gave evidence of common problems and contrasted the variations in progress throughout the country. Mr. J. Goodfellow, the Chairman of the Society, presided over the session.

Wednesday

Wednesday morning was devoted to Town Planning and Air Pollution. Professor J. K. Page of Sheffield University approaching the question as a building scientist and Dr. S. R. Craxford and Mrs. M.-L. P. M. Weatherley emphasizing the recorded facts about pollutants that have special relevance to the siting of new towns and housing and industrial estates. The Chairman of the session was Mr. Stanley E. Cohen, the Hon. Treasurer of the Society. The afternoon saw organized parties setting off on tours of investigation into technical problems close at hand. Visits were made to the Imperial Chemical Industries Works at Billingham, the National Coal Board Group Heating Scheme at Billingham (providing an opportunity to examine the new town centre) and to the Park Gate Steel Works at Rotherham. The competitive instincts of those delegates sufficiently skilled to participate found expression in an exciting golf tournament held on the Pannal Course. A trophy, to be competed for annually, was presented by the Solid Smokeless Fuels Federation.

Thursday

Assurances on the future of smokeless fuel supplies were given by leaders of the fuel industry on Thursday morning. Sir Henry Jones, Chairman of the Gas Council, Mr. C. T. Melling, of the Electricity Council, Mr. Frank Wilkinson of the National Coal Board and Mr. E. Rendall of Shell-Mex and B.P. Ltd., were agreed that the fuel industries were well able to meet the demands of the spread of smokeless zones. The President of the Society, Dr. A. Parker, chaired the session. In the afternoon the Des Voeux Memorial Lecture was revived after a lapse of a few years. The speaker was Dr. J. S. Carter and his paper "A Century of Achievement" gave adequate emphasis to the importance of industrial pollution control and an insight into the progress achieved by the Alkali Inspectorate using persuasion and reason as their main instruments of enforcement. The occasion marked the retirement of Dr. J. S. Carter as Chief Alkali Inspector and was chaired by the Society's senior deputy chairman, Mr. T. Henry Turner.

Friday

The concluding session, with Mr. Stanley Cayton in the Chair, was devoted to the presentation of the Technical Committee's report on "Sulphur Dioxide as an Atmospheric Pollutant". Dr. J. S. G. Burnett, who had presided over the recurrent meetings of the Committee whose studies, ably assisted by co-opted experts, made the report possible, introduced it to the Conference.

Then followed an examination of some causes and possible methods of control of black smoke in diesel road vehicles. This final paper of the conference was given by H. D. Fawell, Superintendent Engineer, Ministry of Transport, and was regarded as one more step forward in an as yet only partially defined plan needed to establish proper standards of control of all vehicle pollution.

Then followed the moving of the vote of thanks by Alderman W. H. Flowers of Ashton-under-Lyne. In this he paid tribute to the hospitality extended by the Mayor and Mayoress of Harrogate and the Borough Council for the facilities provided, to Lord Sherfield, the President, the Chairman of sessions, the Authors, the Stewards, both on the floor and the platform, the exhibitors, those who made possible the T.V. Competition, the staff and all those Harrogate Officials and others who had laboured to ensure a successful Conference and Exhibition.

During the Conference there had been a varied programme of entertainments and social events. These had included a Civic Reception and Dance in the Royal Hall, a Fashion Entertainment for delegates' ladies in the Lounge Hall, a theatre performance in the Opera House, a conference lunch attended by 350 delegates and a coach tour for the ladies to Kirkstall Abbey and Folk Museum.

Address

by

The Rt. Hon. Lord Sherfield

I AM honoured by your invitation to open the 31st Conference of your Society. You are, I think, usually addressed by a Minister on these occasions, but clearly the moment was not going to be propitious for a ministerial appearance, and so it is an occasion for what in American baseball is called "a pinch hitter".

I have no kind of expertise in your special field, but I am, like every other thoughtful member of the public, a warm supporter of the objectives of your Society, though I was not aware, as I should have been, of the scope and breadth of your activities, and of the weight of opinion that you are able to bring to bear.

As the owner-driver of a rather low sports car, I am very much aware of the hazards of being caught in a traffic jam within a few feet of a diesel engine pouring out black fumes. One can almost feel one's expectation of life slowly being curtailed. I was, therefore, glad to see that the resolution proposed by your Technical Committee, and carried at the last session of the Conference, about the pollution from road vehicles, was followed by the official action taken in the last year for the spot-check of diesel engined vehicles. I do not know whether this was cause and effect. Maybe the Ministry were already moving in this matter, but the time sequence is in the Society's favour; they can fairly take some credit for the outcome, and we can today only applaud the action taken by the Ministry, and urge them not to weary in well-doing.

When your President and Council invited me to come here today, they pointed out that you would have addresses by senior members of the principal fuel industries on the contributions to clean air which their products could make, but that there was no representative of atomic energy, and I was accordingly invited to "pinch-hit" here as well.

Although I handed over the reins of the Atomic Energy Authority to the experienced hands of Sir William Penney a few months ago, my interest in the subject is undiminished, and I should be glad to say a few words about it.

As the latest arrival on the fuel scene, atomic energy should normally be advocated with due discretion and modesty. But since it is so often thought to be an ugly duckling, the child must occasionally stand up for itself.

Atomic power was introduced into the world under military auspices, and in circumstances involving a new form of pollution of the atmosphere which had particularly dangerous and terrifying possibilities.

Some of the fears rubbed off, as it were, on the peaceful applications of atomic energy, which have suffered from a kind of guilt by association. Another handicap, at least as far as public opinion on atomic energy is concerned, has been the effect of the period in which premature (I will not say exaggerated) claims were made for atomic energy at a time which a French writer has named "the years of euphoria". It is, therefore, just worth reminding ourselves of a few facts.

Three and a half per cent of the installed capacity of electric power capacity in the United Kingdom is now nuclear, and by 1969 this will have risen to eight per cent. Since this capacity is almost entirely base load, the actual proportion of electricity consumed which is produced by nuclear stations is, and will be, a much higher percentage.

Impeccable Performance

The first graphite gas-cooled reactor producing electric power, started up eight years ago at Calder Hall and the eight reactors of this type which came into production between 1956 and 1960 have performed impeccably at a power rating of 30 per cent above their design capacity. They have achieved an availability of over 90 per cent in each of the last two years.

The nuclear power stations based on the Calder Hall type, once commissioned, have performed with similar reliability, and Hunterston, the latest to achieve full power, is, within two months of the second of the two reactors being commissioned, already achieving an output of electricity seven per cent above its design capacity.

Once commissioned, any difficulties experienced by nuclear power stations have arisen not from the nuclear part of the installation, but from the conventional side, boilers, turbines, and so on; difficulties which have also been experienced with the more advanced conventional power stations.

The fuel used in the Calder Hall type reactors has shown remarkable reliability, and the Atomic Energy Authority recently announced that it was able to increase the period for which it was prepared to guarantee this fuel by one third, an important contribution to the economic return.

The prototype of the more advanced type of gas cooled reactor has now been in operation at Windscale for well over a year. There are 33,000 fuel elements in this reactor. On an average, they have reached a third of their design life, some of them are already half way there, and not one has failed.

The experimental fast breeder reactor at Dounreay has now been operating at its full design power for over a year. It seems certain now that this type of reactor, which can use the plutonium bred in the large gas cooled reactors, will be technically successful on a large scale.

Similar success stories can be told of different type of reactors in other countries.

In the decade in which nuclear reactors have been built and developed, there has been only one accident involving any hazard to the public. This was the Windscale accident in 1957, which involved one of the first two reactors of any size built in this country. Though, for a reactor accident, it was a serious one, the worst consequence was some contamination of milk in the area round Windscale.

Economic Aspects

Safety devices are now immeasurably improved, and one can claim that atomic power has proved its technical efficiency, safety and reliability. But the argument still rages about the economics, and this is fanned by the competing claims of different national types of reactors, American, Canadian and British.

I shall not go into what is a very complicated subject.

A White Paper published a few months ago said "detailed studies show that nuclear power is likely to have an economic place in the British electricity system in the early 1970s, and suggest that, thereafter, it will become cheaper than conventional power for the generation of base load". This is certainly a competitor for the under-statement of the year.

My own view is that a number of Governments in highly industrialized countries, can, if they now wish, have electricity from nuclear stations from now on at a cheaper rate than that from any other source of energy. They can get this result from reactors now operating in experimental or prototype size, of three or four different types, if they order tham on a sufficient scale, and are prepared to make the large initial capital outlay. Moreover, the main types of reactor now under development give similar economic results within the margin of error.

But the argument really turns on the pace at which nuclear energy should be introduced, and on the type of reactor most suitable for the conditions in different countries, rather than on whether nuclear power is a good thing, and on this basis I can turn to the specific question of contamination and safety problems.

Excluding the possible hazards of the release of radio-active elements, to which I shall return in a moment, a nuclear power station has great incidental advantages over conventional power stations. There is no release of smoke, grit, dust or of sulphur dioxide. This last substance is the subject of a special report this year by the Technical Committee of your Society, and I need not, therefore, dwell further on its disagreeable properties.

The relative cost of nuclear fuel is low, the quantity required is small, and problems of transport, for example in cold weather, are eliminated. If Hunterston were a coal fuel station, it would need 73,000 tons of coal per month; as a nuclear station it requires a few tons a month of nuclear fuel, which can be brought in a single lorry.

Once a station is built, the disturbance caused to the surrounding countryside is negligible, and when the present stringent siting restrictions are relaxed, nuclear stations, which will in future be of smaller dimensions, can be placed much nearer to the main industrial centres, with saving of transmission costs.

When gas refrigerators were put on the market in the United States, I remember an advertisement which read: "Your goldfish makes more noise than a gas refrigerator". An analogous statement could be made in respect of nuclear power stations.

There remains, therefore, the question of the hazards of radiation.

Hazard Controls

Partly as a result of the association with atomic fall-out, and partly because it apparently introduced a new hazard to mankind, the controls which have been exercised over the atomic energy industry have been much more stringent than those which have been exercised over any other industry in the development stage. They are, for example, much more stringent than those which have been imposed on the chemical industry.

The controls are based on recommendations of the International Commission on Radiological Protection, which, on the advice of competent authorities in this country, are converted into rules and regulations binding on the atomic energy industry. The levels which are set in these regulations are extraordinarily rigorous. In parts of India and in Brazil, the population is regularly subject to levels of radiation from three to eight times that which is permitted in this country. To give two small examples, water discharged from radiation laboratories and installations in the Thames valley, is required to be purer than the water into which it flows. Anybody who regularly eats two brazil nuts a day will exceed the yearly intake of a radio-active material Radon 226 prescribed by the International Commission. Similar restrictions are imposed on releases to the atmosphere.

The enforcement of these stringent standards in comparison with the enforcement of standards of other types of pollution, is simplified because radio-active materials can be detected and accurately estimated at very low concentrations by relatively inexpensive instruments. Not only are the controls extremely strict, but the methods of supervision are easy and accurate.

The same drastic type of controls are imposed on the siting of nuclear reactors. These were drafted originally so as to provide a safeguard against what was called "the maximum credible accident", and it will be immediately apparent that if anybody regulated his life on such a principle he would never even get out of bed.

An enormous amount of research and development has gone into making nuclear reactors safer than safe, and there is now every assurance that the effects of even the most violent and improbable failure in a nuclear installation would be contained within the building in which it is situated, and that there would be no release of radio-activity to the atmosphere. Of course, this type of hazard is not the only circumstance controlling the siting of nuclear power stations, but the loosening of the siting regulations would give more flexibility in the solution of a troublesome problem for the generating authorities.

I am not saying that all these regulations, when they were first drafted, were too stringent in relation to the knowledge and experience available at the time, but the risk is that the controls are rapidly becoming unnecessarily onerous and restrictive in the light of the accumulation of experience and the rapid advance of technical knowledge. It takes a very long time, sometimes years, to pass the legislation, to translate the legislation into orders, to train officials to administer them. Even now the last of the regulations has not been promulgated. We all know that once a code of rules has become embedded in the files and in administrative practice the need for the particular type or level of regulation may have gone by, yet the effort to amend them is often thought to be too great, or if made, takes a similarly long period.

Proper precautions and a system of control will always be needed, but I think there is certainly a risk that the development of the peaceful applications of atomic energy for the benefit of the people of this country, and many other countries, may be handicapped by an albatross of regulations which, as it turned out, need never have been hung round its neck, and which bureaucratic inertia may make it impossible to cut away.

Continual awareness and willingness to modify the atomic energy regulations in the light of experience are needed if such an outcome is to be avoided.

Other industries have been less harassed, partly because their kind of pollution is less easy to measure, and its effect less easy to demonstrate than in the case of atomic energy, partly, too, because public opinion is not normally so acutely aroused by the indirect effects of smog, smoke and so on, as by the idea of radio-activity.

So my message to you is: "If you want to have cheap power with clean air, go nuclear".

On this clarion note, I have great pleasure in declaring this Conference open.

Presidential Address

by

Dr. Albert Parker, C.B.E., D.Sc., F.R.I.C., M.I.Chem.E., F.R.S.H.

IN my address a year ago at the Conference at Scarborough I referred to the difficulties that had arisen in some parts of the country in extending or creating new smoke control areas because the local demand for the reactive solid smokeless fuels that can be burned in any type of domestic open grate exceeded the local supplies. I also pointed out, however, that there were ample supplies of the less reactive cokes that can be burned satisfactorily in modern room heaters, which provide twice as much useful heat into the room or house as the open fire for the same weight of fuel.

The situation has been carefully considered by the Government Departments concerned. In December, 1963 the Minister of Power presented a white paper on "Domestic Fuel Supplies and the Clean Air Policy" in which the availability of the several smokeless fuels and forms of energy in relation to the demand was reviewed and estimates were made of the probable position in 1965, 1970 and 1975. This excellent white paper was accompanied by a helpful circular from the Ministry of Housing and Local Government, in which it was stated that in future the installation of openable stoves, under-floor draught open fires or fixed gas, electric storage, or oil heaters would be regarded as "reasonably necessary" works in smoke control areas and that the full expenditure on such installations should rank for grant under the Clean Air Act. This was a welcome step forward in encouraging the installation of the efficient, though more expensive, appliances in place of the former policy of basing the grant on the installation of the so-called improved, but cheap and inefficient, open grate.

With the installation of the more efficient appliances, the amounts to be paid in grant by the Government (40 per cent) and by the local authority (30 per cent) will be greater than formerly. The Government has definitely undertaken to pay the 40 per cent; many local authorities are willing to pay their share of 30 per cent but unfortunately some local authorities seem to be reluctant. The house owner or occupier will also have to pay more in his share of the cost of the new appliance and its installation, but he obtains a much more efficient heating unit at a bargain price of only 30 per cent of the real cost. He certainly does not obtain his more expensive television set on such advantageous terms.

Many enlightened local authorities have been encouraged by the arrangement whereby grant can be paid for the much more efficient appliances and they are proceeding to establish further smoke control areas on the new basis. Some authorities have used the situation, with the greater initial cost, as an excuse for taking no action or for delaying action in establishing smoke control areas; and some authorities have even applied to the Ministry for the suspension of smoke control orders that are in operation.

It would be interesting to know to what extent the withdrawal and deferment of smoke control orders and the applications for the suspension of orders have been the result of majority opinion in the areas concerned, the pressure of a minority, or the personal views of the members of the Council of the local authority. Precise answers to this question would be difficult to obtain without a referendum or public opinion poll in each district and the answer would probably vary from one district to another.

Domestic Fuel Consumption

A study of the changes during the past twenty-five to thirty years in the relative popularity of the different fuels for domestic requirements, however, does give a measure of the trend of change in the householders' choice. In Table 1, figures in millions of tons per annum are given for the coal equivalents of the amounts of bituminous coal, anthracite and dry steam coal, coke and other carbonized solid fuels, and electricity, gas and oil used in the years 1938, 1956, and 1963 for domestic requirements in Great Britain. The Table also includes figures for the population in each of the three years and the coal equivalent of the total domestic fuel consumption per capita per annum.

In Table 2, the amounts given in Table 1 for (i) bituminous coal, (ii) solid smokeless fuels, and (iii) the more refined fuels electricity, gas and oil, are expressed as percentages of the total coal equivalents of the fuels used for domestic needs.

The figures in Tables 1 and 2 clearly show that over the eighteen years from 1938 to 1956, that is before the Clean Air Act, 1956 could have had any effect on the relative amounts of the different fuels used in domestic appliances, there had been a substantial reduction in the consumption of household coal, a small increase in the quantity of solid smokeless fuels, and a large increase in the consumption of

Table 1.—Domestic Fuel Consumption in Coal Equivalents in Great Britain in 1938, 1956 and 1963

Year	1938	1956	1963
Millions of tons of coal equivalent			
Bituminous house coal, including miners' coal ..	48·9	35·9	30·3
Anthracite and dry steam coal	1·5	1·6	1·7
Coke and other carbonized solid fuel	3·0	4·0	5·9
Electricity	3·7	14·7	31·0
Gas	6·9	9·2	9·3
Oil	0·8	1·4	3·8
Total	64·8	66·8	82·0
Population, millions	46·2	49·8	52·2
Coal equivalent per capita, tons	1·40	1·34	1·57

Table 2.—Domestic Consumption of Bituminous Coal, Solid Smokeless Fuels, and the Refined Fuels (Electricity, Gas and Oil) as Percentages of the total in Great Britain in 1938, 1956 and 1963

Year	1938	1956	1963
Bituminous coal	75·5	53·7	36·9
Solid smokeless fuels	6·9	8·4	9·3
Electricity, gas and oil	17·6	37·9	53·8
	100·0	100·0	100·0

electricity, gas and oil considered together.

The replacement of solid fuels by the more refined fuels was accelerated during the 1939-1945 war and for some years afterwards by the rationing of domestic coal supplies; but the release of coal supplies with the termination of rationing did not lead to a reversion to a greater use of household coal. Since 1956, there has been a further reduction in the amount of household coal consumed and a further increase in the domestic consumption of solid smokeless fuels, electricity, gas and oil. This trend has definitely been encouraged by the establishment in many parts of the country of smoke control areas under the Clean Air Act. There is no doubt, however, that much of the change to the more refined fuels has been due to the desire of householders generally for greater comfort, cleanliness, and convenience in their methods of domestic heating, particularly in households in which the housewife goes out to work.

For the country as a whole, the rate of change from bituminous coal to the cleaner and more refined fuels for domestic requirements was greater over the seven years 1956 to 1963 than it was over the preceding eighteen years from 1938 to 1956; but there have been large differences in the rates of progress in different parts of the country. In general, progress has been greater in the south than elsewhere, though there are exceptions to this broad generalization.

Over the twenty-five years from 1938 to 1963, the annual domestic consumption of coal, including miners' concessionary coal, in Great Britain fell from about 49 million to 30 million tons, while that of solid smokeless fuel rose from 4·5 million to 7·6 million tons; electricity consumption rose from 5,360 million to over 50,000 million kilowatt-hours, gas from 925 million to more than 1,500 million therms, and oil from less than 0·5 million tons to more than 2 million tons. In 1938, bituminous coal provided 75 per cent of domestic heating and solid smokeless fuel 7 per cent, while electricity, gas and oil provided 18 per cent. By 1963, bituminous coal accounted for only 37 per cent, solid smokeless fuel for 9 per cent, while electricity, gas and oil provided 54 per cent.

The changes in the relative proportions of the different fuels used for domestic requirements have had a beneficial effect in reducing the amount of air pollution from domestic chimneys, in spite of the fact that there has been a considerable increase in the total amount of fuel and energy used in dwellings. The amount of smoke discharged from domestic chimneys has decreased from 1·7 million tons in 1938 to 1·3 million tons in 1956 and 1·1 million tons in 1963; and the quantity of sulphur dioxide from domestic chimneys has fallen from 1·27 million tons in 1938 to 0·95 million tons in 1963. Even so, the domestic chimney in Great Britain in 1963 was responsible for more than three-quarters of the total amount of smoke discharged to the atmosphere. The relative effect of domestic smoke in polluting the air we breathe is greater than this proportion indicates because the smoke is discharged at low level and at a low temperature and is not so readily dispersed and diluted in the air as the discharges from higher factory chimneys.

There is no doubt that the rate of reduction in the amount of smoke emitted from domestic chimneys could be increased if all local authorities, and particularly those in the black areas, made an effort to establish smoke control areas as rapidly as practicable.

The lack of effort on the part of some local authorities to establish smoke control areas may be due to several causes. It may be that a section of the local community, including some of the older, influential members, dislike any change from the traditional open fire burning coal, highly inefficient as it is, to any new system however efficient, and they are averse to trying new methods. It may also be that the people have not properly been informed about the costly, detrimental effects of air pollution on health and property; nor fully informed about the advantages of the newer methods of heating in cleanliness, comfort, and convenience.

It has been said by those who oppose change that most people cannot afford to bear the cost of replacing open fires burning bituminous coal by room heaters using solid smokeless fuel, electricity, gas or oil. The fact is that for the same amount of useful heat the capital and installation cost of a room heater burning hard coke is covered in three years by the saving in the cost of the fuel consumed, owing to the high efficiency of the new appliance; or the 30 per cent paid by the house owner or occupier is covered in one year by the saving in fuel. If the householder decides to have the greater comfort of 25 per cent more useful heat, then the cost of the room heater burning hard coke is covered in about six years by the saving in fuel costs; or the 30 per cent paid by the householder is covered in two years. These statements on cost can be checked from the tables of estimated costs included in the white paper issued in December, 1963 by the Minister of Power.

It has often been asserted that those dependent on small, old-age pensions cannot afford the higher price per ton for coke as compared with coal. This is a fallacious argument because the quantity of coke required in the new appliance for the same amount of useful heat is so much less than the quantity of coal needed with the old open fire that the cost of the coke used is less than that for the coal. Another argument is that the supplies of coke are or soon will be insufficient to meet the needs of room heaters designed to burn hard coke. This is not correct. Admittedly, in bad weather in the winter many householders with storage space for no more than one or two weeks' consumption of coke are unable to obtain fresh supplies at sufficiently frequent intervals, owing to difficulties of transport and heavy seasonal demands on the fuel merchants. These difficulties arise from bad planning in not providing the dwellings with adequate storage space for solid fuel; they are not due to shortage of coke.

Future Demand

In Appendix I of the white paper presented in December, 1963 by the Minister of Power, estimates were given of the demand for solid smokeless fuels for domestic use in 1965, 1970 and 1975 and of the supplies of these fuels likely to be available on the basis of the then existing plans of the producers of the fuels. According to those estimates the demand in 1970 would be about 11·2 million tons as compared with a planned supply of 9·65 million tons. The estimates included the several types of solid smokeless fuels in the quantities given in the following Table 3.

According to these estimates there will be a shortage of solid smokeless fuels suitable for open grates and a surplus of solid fuel suitable for room

Table 3.—Estimates of the Demand and Planned Supply of Solid Smokeless Fuels for Domestic Use in 1970 as given in the White Paper presented by the Minister of Power in December, 1963

Type of Solid Smokeless Fuel	*Millions of Tons* *Demand*	*Supply*
Reactive fuels that could be used in any type of open grate	3·4	2·8
Gas coke suitable for use in improved open grates ..	3·3	1·9
Other fuels suitable for use in closed appliances ..	4·5	4·95
Totals	11·2	9·65

heaters. If experience during the next two or three years indicates that the demand will by 1970 reach the amounts of the estimates in Table 3, no doubt the producers will expand production to meet the demand. The uncertainty is whether or not the demand will be so high as 11·2 million tons of solid smokeless fuel in 1970. In my opinion it is doubtful whether it will reach 10 million tons a year by that time.

If it is assumed that the change in the quantities of bituminous coals and of solid smokeless fuels required for domestic use will be the same over the seven years 1963 to 1970 as they have been over the seven years 1956 to 1963 as given by the figures in Table 1 of this address, the demand for household coal in 1970 will be about 24·7 million tons as compared with 30·3 million tons in 1963; and the demand for solid smokeless fuels in 1970 will be about 9·6 million tons as compared with 7·6 million tons in 1963. There would be no difficulty in meeting a demand of 9·6 million tons of solid smokeless fuel in 1970 on the basis of present planned production provided that the increased use of the fuel is mainly in efficient room heaters.

It may be that by 1970 the total annual demand for fuel and energy for domestic needs will reach the equivalent of 90 million tons of coal, that is eight million tons more than in 1963. In such case, it seems to me that 25 million tons will be met by bituminous coal, no more than 10 million tons by solid smokeless fuels, and the remaining 55 million tons of coal equivalent by electricity, gas, and oil. In making these estimates, I have taken into account what I consider to be the probable progress in the establishment of smoke control areas, the probable changes in the relative prices of the different fuels, and the growing desire of householders to have more efficient and convenient systems of heating. It is difficult to estimate to what extent the extra demand for domestic heating will be met separately by electricity, gas, and oil. All three will play their part, but the indications are that with the recent developments of less costly methods of production of town gas, the increase in the use of gas during the next six or seven years will be greater than during the last six or seven years.

Total Fuel Consumption

The object of this Society is to encourage and press forward the application of all practicable methods of reducing the pollution of the air we breathe. It is desirable periodically to ascertain what progress has been made in relation to the changes in the amounts and efficiencies of use of the several fuels and to assess and guide progress in the future. In Table 4, figures are given for the consumption of fuels for the main uses in Great Britain in 1938, 1956, and 1963. In Table 5, the amounts of coal, oil, hydro-electricity, nuclear electricity, and colliery methane in each of the three years are given in terms of coal equivalent; and the figures for coal equivalent are also expressed as percentages of the overall totals.

The figures in Table 5 show that the coal equivalent of the total fuel and energy consumption rose from about 192 million tons in 1938 to about 276 million tons in 1963, that is by about 44 per cent. Over the same period the proportion provided by coal fell from 93 per cent to 69 per cent and that provided by oil rose from less than 7 per cent to 29 per cent. In Table 4, the noteworthy points are that in 1963 the consumption of coal at electricity power stations was 4·5 times as great as in 1938, while the amounts used by the railways and collieries in 1963 were only in the region of one-third of the amounts used in 1938.

On the basis of the figures in Table 4 for the consumption of fuels for the several main purposes in 1938, 1956, and 1963, the amounts of smoke and sulphur dioxide discharged into the air in those years have been estimated. The results are given in Table 6.

Smoke

According to the estimates in Table 6, the total amount of smoke discharged in 1963 was about 50 per cent

Table 4.—Main Uses of Fuels in Great Britain in 1938, 1956 and 1963 in Millions of Tons

Year	1938	1956	1963
Coal			
Domestic, including anthracite and dry steam coal	50·4	37·5	32·0
Electricity works	14·9	45·6	66·8
Railways	13·2	12·1	4·9
Collieries	11·9	7·9	3·9
Industrial, etc.	49·4	54·3	37·9
Coke ovens	19·1	29·3	23·5
Gas works	19·1	27·8	22·1
	178·0	214·5	191·1
Coke (excluding consumption in gas works and blast furnaces)			
Domestic, including other carbonized solid fuels	3·0	4·0	5·9
Industrial and miscellaneous	7·9	11·6	9·3
Oil			
Domestic			
Kerosene and domestic fuel oils	0·6	0·9	2·1
Industrial			
Kerosene, gas/diesel, fuel oils and creosote-pitch	1·7	11·2	30·8
Road and Rail Transport			
Motor spirit, gas/diesel and fuel oils	5·2	8·1	13·1
Marine Craft			
Gas/diesel and fuel oils	0·1	0·8	1·1
	7·6	21·0	47·1

Table 5.—Fuel Consumption in Great Britain in 1938, 1956 and 1963 in Coal Equivalents, Millions of Tons and Percentages

Year	1938	1956	1963
Coal	178·0	214·5	191·1
Oil (factor 1·7)	12·9	35·7	80·2
Hydro-electricity	0·7	1·3	1·8
Nuclear electricity	—	—	2·5
Colliery methane	—	—	0·1
	191·6	251·5	275·7
Percentages of Totals			
Coal	92·9	85·3	69·3
Oil	6·7	14·2	29·1
Hydro- and nuclear electricity	0·4	0·5	1·6
	100·0	100·0	100·0

Table 6.—Estimates of Air Pollution by Smoke and Sulphur Dioxide from the Main Uses of Fuels in Great Britain in 1938, 1956 and 1963, in Millions of Tons

Year	1938	1956	1963
Smoke			
Coal			
Domestic	1·71	1·26	1·06
Railways	0·26	0·24	0·10
Industrial, etc.	0·74	0·75	0·21
Total smoke	2·71	2·25	1·37
Sulphur Dioxide			
Coal			
Domestic	1·21	0·90	0·82
Electricity works	0·40	1·23	2·04
Railways	0·36	0·33	0·14
Collieries	0·32	0·21	0·11
Industrial, etc.	1·33	1·47	1·09
Coke ovens	0·07	0·11	0·08
Gas works	0·14	0·20	0·16
	3·83	4·45	4·44
Coke			
Domestic, including other carbonized solid fuels	0·06	0·08	0·12
Industrial, etc.	0·18	0·27	0·22
	0·24	0·35	0·34
Oil			
Domestic	—	—	0·01
Industrial	0·05	0·47	1·48
Road and Rail Transport	0·01	0·03	0·06
Marine Craft	—	0·03	0·04
	0·06	0·53	1·59
Overall total	4·13	5·33	6·37

of the amount in 1938 and 60 per cent of the amount in 1956. Smoke from domestic chimneys in 1963 was as high as 84 per cent of the amount in 1956, whereas the amount of smoke from industrial chimneys in 1963 was less than 30 per cent of the amount in 1956. Obviously, greater progress has been made in reducing air pollution by industrial smoke than by domestic smoke; yet for the same weight of smoke the discharges from low-level domestic chimneys have a greater polluting effect on the air we breathe near ground level than the discharges from the higher industrial chimneys.

The reduction in the amount of smoke emitted from domestic chimneys since 1956 has fallen far short of the target suggested by the Committee on Air Pollution in their report issued in November, 1954. The improvement that has been made, however, has already reduced the concentration of smoke in the air as measured by the instruments in regular use in different parts of the country, particularly in the smokeless zones and smoke control areas. The results of the measurements during the last few years are discussed in the 32nd Report of the Department of Scientific and Industrial Research on the Investigation of Atmospheric Pollution.

Sulphur Dioxide

With an increase in the quantity of fuel used, from the coal equivalent of 192 million tons in 1938 to 251 million tons in 1956 and 276 million tons in 1963, there has inevitably been an increase in the quantity of sulphur dioxide discharged into the air. The amount of 6·37 million tons in 1963 was 50 per cent greater than in 1938 and 20 per cent greater than in 1956. Unfortunately, no satisfactory, practicable methods have been developed for appreciably reducing the sulphur contents of coal and of fuel oil, nor of removing the sulphur dioxide from the waste gases. A document on the subject of sulphur dioxide as an atmospheric pollutant has been prepared by the Technical Committee of the Society and is to be presented during this Conference.

Fortunately, there has been some reduction in the emission of sulphur dioxide from low-level domestic chimneys. The whole of the increase has been in the emissions from high industrial chimneys, particularly the very high chimneys of the newer power stations. As a result, there has been no measurable change during the last few years in the concentration of sulphur dioxide in the air near ground level.

So far, I have reviewed the position in relation to pollution of the air by smoke and sulphur dioxide and have assessed the rate of progress of efforts to decrease the pollution. Progress has been good in some areas but far too slow in others. To reduce pollution by smoke it is essential that much of the bituminous coal that is now used in very inefficient domestic appliances should be replaced by really efficient appliances using solid smokeless fuel, electricity, gas, and oil. The changes in this direction will come as householders recognize the advantages in comfort and convenience, but far too slowly unless all local authorities in the densely populated districts take steps to establish smoke control areas as rapidly as practicable. More efficient domestic appliances burning solid smokeless fuel, and the replacement of more of the coal by electricity, gas, and the types of oil used for domestic heating will also reduce the amount of sulphur dioxide emitted from domestic chimneys and thus the pollution of the air near ground level.

The Ministry of Housing and Local Government gave the lead for future action in relation to domestic heating in the circular issued in December, 1963; and the Minister, the Rt. Hon. Sir Keith Joseph, honoured the Society and encouraged all who desire to have cleaner air by his stimulating addresses in April last at the Society's annual general meeting and luncheon. We now look to those local authorities who have been slow in action in the past to move ahead quickly in establishing smoke control areas.

In addition to smoke and sulphur dioxide, other pollutants discharged into the air from the use of fuels include carbon monoxide, hydrocarbons, aldehydes and other compounds of carbon, and oxides of nitrogen. There are also the pollutants from a variety of industrial processes such as those registrable under the Alkali, Etc. Works Regulation Act, 1906, which is to be the subject of the Des Vœux Memorial Lecture to be given during this Conference. It is not possible in one address to consider the problems of mitigation of air pollution by these various contaminants. It should be mentioned, however, that the quantity of carbon monoxide discharged into the air of Great Britain from the use of fuels is at least 20 million tons a year, or more than three times the amount of sulphur dioxide; this quantity of 20 million tons includes at least five million tons from the exhaust pipes of road vehicles and these exhaust fumes are discharged at low level. In my opinion, research efforts should be directed to the design and methods of operation of the engines for road vehicles that will achieve complete combustion of the motor spirit, in preference to having incomplete combustion in the engine and then treating the exhaust gases in after-burners.

The major product of the combustion of fuels is carbon dioxide and the amount of this gas discharged annually into the air of Great Britain from the use of fuels is in the region of 600 million tons. Carbon dioxide is also a major constituent of the air exhaled by animals; the weight exhaled annually by the population of this country is about 15 million tons. Though carbon dioxide is not nearly so polluting as the other substances usually considered, its concentration, with that of accompanying substances, must be kept down in crowded rooms by efficient ventilation if unpleasant and unhealthy conditions are to be avoided.

For the combustion of the coal and oil used annually in Great Britain the minimum quantity of air required is about 2,700 million tons, which would occupy 600 square miles to a height of one mile. Fortunately, except at times of temperature inversion which causes dense fog, nature has provided an efficient ventilation system. Usually, the velocity of the wind is sufficient to ensure that the air over Great Britain is completely replaced in less than three days by air from outside the country.

But there are limits to the amounts of pollutants that the air with its ventilating system can accept and discard in one form or another without detriment to health and property. Experience in the past demonstrated in no uncertain manner that there are limits to the amounts of polluting matter that rivers and other water courses can receive without detriment to health. It is equally important to ensure that the limits of air pollution are not again exceeded as they have been in some areas in this country with serious results, particularly at times of fog.

Smoke Control Areas

Regional Reports on the Present Situation, compiled and presented on behalf of the Society's Divisions

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SCOTLAND

by John Innes, M.B.E.

SCOTTISH Local Authorities have, it is regretted, shown little enthusiasm for domestic smoke control but there are, of course, some notable exceptions where, despite general apathy and even hostility, Orders are being made. In the early months of 1963 there were indications of growing interest, but the White Paper on Domestic Fuel Supplies and the Clean Air Policy, and the consequential circular from the Central Authority has caused interest and enthusiasm to decline.

Choice of solid fuels is severely restricted for those who live in smoke controlled areas and it is felt that, in this connection, Scotland is unfavourably placed. Gas Works' coke, irrespective of its quality, has, by tradition, few Scottish protagonists and current costs for the fuel are generally declaimed as excessive. There is, in Scotland, a great dearth of premium fuels and the limited supplies that we have must bear the burden of extra transport to the North.

A recent inquiry addressed to Scottish local authority members of the Society reveals that, by the end of 1965, it is expected that a further 31 new Orders will be made. These will extend to some 13,000 acres and control a further 82,000 houses.

Unless, however, there is a realistic approach made in order to improve fuel supplies and their cost, it is feared that advancement in the control of domestic smoke will be seriously protracted. Among the few enthusiastic authorities there is obviously a feeling of frustration and disappointment which does not augur well for clean air in Scotland.

NORTH-WEST

by J. Kay, D.P.A.(Lon), F.A.P.H.I., M.Inst.P.C.

Introduction

THE Government review of the forward supply position of solid smokeless fuels for domestic use is reported in the White Paper entitled "Domestic Fuel Supplies and the Clean Air Policy" dated December, 1963. Prior to the issue of this report, local authorities in the North West received from the Minister of Housing and Local Government a letter, dated October 11, 1963, which revealed that for the future these local authorities could not rely on adequate supplies of open fire coke being available for proposed smoke control areas. The anticipated shortage of open fire coke in the North-West (and elsewhere) resulted in the issue, by the Minister of Housing and Local Government, of Circular 69/63 on December 17, 1963. This Circular has been the subject of debate in local government circles ever since and has evoked various and divergent opinions. The contents of the Circular are well-known and the author of this report must content himself with an appraisal of its repercussions.

Public Opinion

In the early months of this year public opinion was undoubtedly influenced by press reports of resolutions by local authorities to suspend the creation of smoke control areas, or, in some cases, to seek revocation of existing Orders, and in one case to dispense with the services of the smoke control officer. In one town, a protest march was organized to demonstrate grievances against the price and quality of certain smokeless fuels. Elsewhere false prophets have arisen to deprecate the methods being used to achieve a clean air policy, by Central and Local Government alike. Because the spectacular usually receives greatest publicity, an assessment of solid public opinion was sought from Public Health Inspectors in the "black areas" of the North-West with the result shown in Table 1.

Local Authority Opinion and decisions

The analysis of replies to a questionnaire (dated June, 1964) furnished by Chief Public Health Inspectors in the "black areas" reveals a rather disconcerting position as far as the opinions of elected members of some local authorities are concerned (Table 2).

The reasons advanced by local authorities to justify their decisions are indicated briefly:

(*a*) *Refuse to implement:* Time not opportune; high cost of fuel; Ministry should meet all charges; awaiting progress by adjoining authority down wind.

(*b*) *To discontinue:* Sense of frustration; staff encouraged to find new employment.

Table 1: State of Public Opinion

	Public Opinion on Domestic Smoke Control			
Type of Local Authority	*Enthusiastic*	*Approving*	*Indifferent*	*Hostile*
County Boroughs	—	9	5	2
Municipal Boroughs ..	—	11	10	1
Urban Districts	—	10	27	6

Table 2: On the Creation of Smoke Control Areas

Type of Local Authority	*Decision of Local Authorities in Black Areas*					
	Accelerate Programme	*No Change*	*Suspend Temporarily*	*Suspend*	*Discontinue*	*Refuse to Implement*
County Boroughs	2	9	2	2	1	—
Municipal Boroughs	1	16	—	5	—	—
Urban Districts	—	10	6	14	2	11

(*c*) *To suspend:* Increased expenditure; quality and availability of smokeless fuel; non-co-operation of miners; staff shortage; seeking suspension of operative Orders; will resume if cost reduced.

(*d*) *To suspend temporarily:* Awaiting result of Inquiry; decision after next survey; staff shortage; Exchequer should bear full cost; in favour of clean air; anxious to go ahead.

(*e*) *No change:* Will review when next Order confirmed; wholly in favour except increased costs; increased costs may slow programme; should abolish air pollution.

(*f*) *To accelerate:* Acceleration decided before fuel crisis; additional staff to be engaged; undoubted benefits from clean air; cost of air pollution to nation.

Table III: Council willing to meet increased costs

Type of local authority	*Yes*	*No*	*Under discussion*
County Boroughs	11	1	4
Municipal Boroughs	13	2	7
Urban Districts	11	16	14

Table IV: Council willing to permit freedom of choice (in the case of private dwellings)

Type of local authority	*Unfettered choice of appliances (where "reasonably necessary")*		
	Yes	*No*	*Under discussion*
County Boroughs	14	—	2
Municipal Boroughs	15	—	7
Urban Districts	15	11	14

Acceptability of Appliances

The view is generally held by public health officers that the public is ready to accept openable stoves, gas fires and thermal storage heaters in lieu of the traditional open fire. This is supported by results obtained during surveys where an indication of preferences is sought to enable costs to be estimated realistically, and also by reference to appliances installed in areas becoming operative during the course of this year. From records kept by 27 local authorities the selection of appliances, where open fire coke is not available and electric bar or fan fires are being discouraged, furnish the following proportions, on the average:

Openable stoves	27%
Underfloor draught fires	34%
Gas fires	27%
Thermal storage heaters ("off-peak")	5%
Electric bar or fan	4%
Central heating	3%

These proportions are only mean figures and will not be representative of any one town or any particular smoke control area. They do give an overall picture of the pattern of demand at present. It should be recalled that many of the appliances listed above were actually installed in former smoke control areas when grants were more stringent. Furthermore, this tendency is in line with the present trend of choice towards more efficient appliances for solid fuel and piped and wired fuels for cleanliness and convenience, in areas not yet subject to smoke control. The retail sales of room heaters and underfloor draught fires for solid fuel, gas fires and electric storage heaters have

Table V: Easing Burden of extra cost to householders

Means adopted by Local Authorities	*County Boroughs* Yes	*County Boroughs* No	*Municipal Boroughs* Yes	*Municipal Boroughs* No	*Urban Districts* Yes	*Urban Districts* No
Encouraging Hire Purchase ..	6	9	7	12	5	15
Accepting unpaid invoices as proof of expenditure	8	7	10	9	10	9
Receiving instalments from occupiers for their share of cost ..	1	—	1	—	—	—
Paying grants direct to contractor	2	—	2	—	1	—

Table VI: Domestic Smoke Control in North-West Region
Progress made in Black Areas to June, 1964

Type of Local Authority	*Areas in Operation* Acreage	*Areas in Operation* Premises	*Outstanding Programme* Acreage	*Outstanding Programme* Premises
County Boroughs	34,479	191,088	113,741	861,667
(Number: 17)	(23·2%)	(18·15%)	(76·8%)	(81·85%)
Municipal Boroughs	15,416	55,992	70,621	242,973
(Number: 23)	(18%)	(18·7%)	(82%)	(81·3%)
Urban Districts	14,605	45,427	105,185	245,104
(Number: 44)	(12·2%)	(15·6%)	(87·8%)	(84·4%)

reached record proportions in the country generally. In the North West the sale of gas fires has increased as follows:

Year ended 31.3.62	..	21,008
,, ,, 31.3.63	..	37,967
,, ,, 31.3.64	..	78,778

For electric storage heaters the figures are:

Year ended 31.3.63	..	9,500
,, ,, 31.3.64	..	22,000

The total sales in the United Kingdom of room heaters using solid fuel were 70,000 in 1962, 140,000 in 1963, and 210,000 (estimated) for 1964. No separate figures are available for the sales of underfloor draught fires, but it is known that these have increased in similar proportions.

Progress Achieved and Balance of Programmes

The domestic smoke control achievements in the black areas of the North-West region when taken in the aggregate are not impressive. Out of a total of 1,642,251 premises, only 292,507 are smoke controlled, i.e. 17·8 per cent of the premises in the black areas. The position would have been less favourable but for the efforts of a few local authorities whose programmes are relatively well-advanced, and it is interesting to note that of the 17 County Boroughs, two are jointly responsible for making more than 100,000 premises smoke controlled, i.e. over half of the total number achieved in County Boroughs. In the Municipal Boroughs, five local authorities out of a total of 23 have dealt with more than one-half of the smoke controlled premises, and amongst the Urban Districts we find that two authorities out of 44 have together accounted for 30 per cent of the total premises subject to smoke control orders within the boundaries of Urban District Councils.

Future Prospects

In accordance with replies to the questionnaire, the following table indicates an appraisal of well-informed opinion on the future prospects of smoke control in the North-West. It will be appreciated that the figures represent numbers of local authorities without reference to size or population. Their separation into three types of local authority serves to emphasize the greater difficulties facing the smaller Councils.

Conclusion

Despite the emergence of new problems and the resurgence of

Table VII: Future Prospects

Type of Local Authority	*Good*	*Fair*	*Indifferent*	*Slight*
County Boroughs	6 (37·5%)	8 (50%)	1 (6·25%)	1 (6·25%)
Municipal Boroughs ..	7 (31·8%)	10 (45·45%)	3 (13·65%)	2 (9·10%)
Urban Districts	5 (13·88%)	9 (25%)	10 (27·77%)	12 (33·33%)

	Improved	*Unchanged*	*Less Favourable*
County Boroughs	1 (6·25%)	8 (50%)	7 (43·75%)
Municipal Boroughs ..	2 (9·1%)	11 (50%)	9 (40·9%)
Urban Districts	—	19 (51·35%)	18 (48·65%)

opposition on the part of a minority consequent upon the circumstances surrounding the issue of Circular 69/63, the future prospects for clean air are quite good. This report has indicated a sense of caution on the part of many local authorities in view of the changes in the *modus operandi.* The example of those Councils which propose to press on or even accelerate their programmes can be expected to influence local authority opinion in a decisive manner when the facts of the situation become better understood.

At the time of writing, the main attention of policy makers and public alike is focused on the financial implications of increased expenditure. The many positive advantages of the current clean air policy have been given less prominence than they deserve. Sunbrite, which will be the basic solid smokeless fuel, is a high grade commodity which is slightly cheaper than open fire coke. Room heaters using this fuel are twice as efficient as the open fire, which represents a 50 per cent fuel saving for the same output of useful heat. The appliances enable heat output to be closely regulated, and, using a small amount of fuel, can be kept in overnight to give immediate comfort conditions the following morning. The new production methods will provide cheaper and safer town gas and eliminate scores of small gas manufacturing stations together with their attendant local pollution. Realistic grants will encourage the installation of gas fires and electric storage heaters which furnish added convenience and really smokeless conditions.

Finally, we must emphasize the undoubted benefits of clean air and the price we are paying at present for permitting pollution. Ten years ago this was estimated to cost £10 per head per annum in the "black areas" for those items only which can be given a monetary value, and the figure ignores the less beneficial effect of reduced sunshine, physical discomfort, impaired vitality, ill-health and premature death. For the "black areas" of the North-West region the cost of air pollution is astronomical; in the order of £60,000,000 sterling every year. The expenditure required to effect a cure is only fractional in comparison with the savings which would accrue from the abolition of air pollution.

NORTH-EAST

by L. Mair, F.R.S.H., F.A.P.H.I

WITHIN the boundaries of the north-east division are 75 local authorities of which 24 have been designated as being within the "black area", including at least one county borough which refuses to accept designation as a "black area".

In a region the prosperity of which has long depended upon the coal industry, where the open coal fire is a cherished traditional feature of the home, where the use of concessionary coal is so widespread, and where the climate is generally colder than elsewhere, the pursuance of a policy leading to the abolition from family life of such an important factor as the open fire was to say the least, to be regarded with some hostility. Nevertheless, much progress has been made and despite the grave difficulties, financial and otherwise, which emerged from the Ministry of Housing and Local Government Circular 69/63, the overall position is not without hope.

With a view to formulating a picture of progress in the region as a whole, a carefully prepared questionnaire was addressed to the 24 designated "black area" authorities and it is on the replies received that the following statement is based and which describes the situation as it existed at June 30, 1964. A copy of the questionnaire is attached as an appendix to this report.

Geographical Scope of Questionnaire

Type of Authority	*Total number*	*Number of replies*
County Borough	8	8
Borough	5	5
Urban Districts	11	9
Totals	24	22

Geographical Scope of Questionnaire

Whilst the above returns constitute only 91 per cent of the inquiries made, (the only defaulters being in the Tyneside district) it is felt that the information given is sufficiently complete to enable a reasonably accurate assessment to be made of the region as a whole.

Progress in the Region before August 1963 (date of cessation of availability of soft coke)

In response to the Ministry of Housing and Local Government Circular 5/59 only 11 of the 24 "black area" authorities submitted smoke control area programmes. The progress in these authorities made during the years 1959, 1960 and 1961 following Circular 5/59 can be summarized as follows:

Progress 1959-61

Region	*Proposed Programmes*		
	Premises	*Dwellings*	*Acres*
Tyneside/ Wearside	16,723	13,016	3,276
Teeside	11,228	11,102	3,294
Totals proposed	27,951	24,118	6,570

Region	*Progress Achieved*		
	Premises	*Dwellings*	*Acres*
Tyneside/ Wearside	8,659	5,356	960
Teeside	1,682	1,682	480
Totals covered by orders made	10,341	7,038	1,440
Percentage progress	37	29	22

In response to Circular 4/62 an additional six authorities submitted programmes (making 17 in all with declared programmes) and further progress in the region during the years 1961-1963 is summarized as follows:

Progress 1961-63

Region	*Proposed Programmes*		
	Premises	*Dwellings*	*Acres*
Tyneside/ Wearside	60,305	51,223	12,059
Teeside	27,111	25,122	7,288
Totals proposed	87,416	76,345	19,347

Region	*Progress Achieved*		
	Premises	*Dwellings*	*Acres*
Tyneside/ Wearside	50,871	43,139	9,131
Teeside	13,470	13,414	5,099
Totals covered by orders made	64,341	56,553	14,230
Percentage progress	73	74	74

It is clear that those local authorities with declared programmes were, at mid-1963, making reasonably good progress, albeit some 26 per cent short of their objectives, and there is little doubt that, with the gathering momentum of smoke control activity, most target dates for the completion of programmes would have been achieved if no unexpected obstacle to progress had arisen. However, on August 1, 1963, the Minister of Housing and Local Government addressed a letter to all authorities in the Northern Region in which he asked that any further smoke control orders be based on the assumption that smokeless fuel other than open fire coke would be used and that orders submitted and awaiting confirmation should be reviewed on that basis. This was a severe blow to progress in the region as indicated in the following table:

Orders submitted but not confirmed and held in abeyance

Region	*Orders*	*Premises*	*Dwellings*	*Acres*
Tyneside/Wearside ..	14	24,128	23,558	3,815
Teeside	3	3 274	3,223	915
Totals in abeyance ..	17	27,402	26,781	4,730

Of the above 17 Orders, at least 3 have been revoked and 7 withdrawn leaving 7 to be the subject of further review in the light of the continuation or suspension of smoke control programmes.

Progress since August 1963

Taking the region as a whole there has been virtually no effective progress in domestic smoke control since the publication of Circ. 69/63.

Not one of the 17 "black area" authorities with a submitted programme intends to adhere to such programme. In 9 cases, programmes have been suspended for the time being until conditions are more favourable and in 8 authorities, it is intended to modify the programme to enable the establishment of smoke control areas to continue at a much slower rate. In one of the areas, (a large county borough) where the programme had been suspended, the opinion was expressed that it was now very doubtful if smoke control will ever become an accomplished fact in that district.

The reason given for these changes of policy was, almost without exception, one of increased financial expenditure, although in three cases this justification was reinforced by a resistance to smoke control in principle. In no case was the lack of availability of solid smokeless fuels given as the reason, although one authority stated that it was the uncertainty of the future of smoke control generally which had caused the suspension of their programme.

Increased Financial Expenditure

Because of the crippling effect on smoke control programmes of the financial implications of Circ. 69/63, a detailed analysis of conversion costs was obtained from the "black area" authorities. The cost of a fireplace conversion prior to August 1963, (i.e., on a soft coke basis) ranged from £4 14s. 2d. to £23 17s. with an overall average of £14 3s. The estimated average cost of conversion to a hard coke burning appliance in these same authorities ranged from £30 to £90, the overall average being £49.

In a region which has not, for generations, enjoyed a fair share of national prosperity, it is not difficult to understand a certain reluctance in municipal circles to continue with a project, the cost of which has increased some three and a half times overnight, as it were, added to which must be the vastly increased number of conversions of fireplaces which had hitherto been approved for the use of soft coke.

Availability of Smokeless Fuels

Smoke control programmes in the north-east region are, and will continue for some considerable time, to be based on conversions to hard-coke burning appliances and in this respect official assurances indicate that there will be ample supplies of Sunbrite to meet all demands for at least ten years hence, and in all probability for even a much longer period. There is no indication that the smaller demand for gas appliances cannot be adequately met by the Gas Board services and although the position in relation to electricity supplies is rather less clearly defined, the general demand for conversion to electrical appliances in the region is so small that it is unlikely that any serious difficulties in this respect will be encountered in the immediate future.

Acceptance of different appliances

This aspect of the situation was dealt with in Question 10 of the questionnaire and although there was some small confusion indicated in a few of the replies it is quite clear that the solid fuel room heater will be the most popular appliance in future smoke control areas. In one county borough it was estimated that the room heater would be accepted by 97 per cent of householders, but the general average throughout the region appears to be in the neighbourhood of 70 per cent. The remaining 30 per cent comprises, gas fires 20 per cent, with an uncertain proportion of oil fires, electric storage appliances and central heating installations making up the remaining 10 per cent.

Public Opinion on Smoke Control

The questionnaire classified public opinion as (a) very favourable, (b) favourable, (c) non-committal, (d) unfavourable and (e) actively unfavourable. (see question 11)

Of the 22 questionnaires returned only 18 answered this particular question as follows:

Very favourable	nil
Favourable	11
Non-committal	4
Unfavourable	2
Actively unfavourable	1

No specific enquiry was made as to the present state of local authority opinion in the "black area" authorities but it can reasonably be assumed that local authority opinion is, for a number of reasons, slightly less favourable than that indicated above.

The Future

The north-east region has undoubtedly sustained a severe setback in smoke control progress because of the restrictive effect of the implications of Circ. 69/63 but in the long term, the future prospects are, nevertheless, fairly encouraging.

In the main, most smoke control programmes are to be resumed, even if on a modified longer-term basis and the remaining authorities will almost certainly follow this example in due course. Perhaps the most positive sources of encouragement lie in (a) the increasing number of local authorities who are adopting a policy of clean air in connection with future development, particularly in relation to council dwellings, and (b) the development of group heating, a conception of smokeless heat distribution, introduced and developed by the Northumberland and Durham Division of the National Coal Board.

(*a*) *Council Dwellings and New Development*

In approximately half of the local authorities in the region all new council houses and flats are either fitted with stoves designed to burn hard coke or such dwellings are all-gas or all-electric. In many cases, proposed housing estates are being designated as smoke control areas in advance of housing development and a particularly encouraging feature is that two of the proposed new towns in the region are themselves to be declared smoke control areas.

(*b*) *Group Heating*

Of all the aspects of atmospheric pollution control in the north-east, perhaps the most progressive and in the long-term, most effective, will be the development of group heating and it has been stated, during the next 15 years or so progress in this field should be spectacular. Group (or district) heating, as developed in the north-east, is particularly suited to the redevelopment of central areas to include not only residential accommodation but also commercial and industrial premises. A coal-fired boiler plant is housed in a central boilerhouse architecturally designed to blend with the proposed development, from which boiler plant hot water, either at medium or low pressure, is distributed via a ring main to consumer premises and is delivered at a temperature of 120/180°F. The heat is metered at the exit from the boilerhouse or at the point of delivery to the individual premises and rapid progress has recently been made in small meter technology.

Fuel is delivered pneumatically to overhead bunkers in the boilerhouse by a coal tanker delivery service and ash is similarly removed, both operations being dustless. Obvious advantages will be a maximum of convenience and saving of labour to the householder and a clean atmosphere for all. The Northumberland and Durham Division of the National Coal Board have eleven group heating schemes which are either at the building stage, on the drawing board or are being negotiated. The most advanced scheme is being operated by the Billingham U.D.C. and already, in the initial stages of installation, a shopping block, an hotel extension and a factory are being supplied with metered heat. Preliminary work of site clearance for similar plants has been started at Sunderland and Washington, with the largest projected scheme, so far, to be at Newton Aycliffe where the plant is designed to consume smokelessly some 35,000 tons of coal annually.

It is not unlikely that group heating and smokeless development as outlined above, will in due course prove to be more effective in securing the abatement of coal smoke than the painfully slow and cumbrous procedure of establishing smoke control areas under the provisions of the Clean Air Act, the penal character of which method often changes apathy and disinterestedness into active antagonism, a feature which is inimical to the natural and inevitable evolution of clean air.

Acknowledgments

This report could not have been prepared without the valuable assistance of those chief public health inspectors in the north-east region who so readily co-operated by completing and returning a somewhat involved questionnaire. These officers performed the real work of this survey—I have acted merely as a recorder of facts and an interpreter of circumstances.

APPENDIX

QUESTIONNAIRE TO NORTH EAST REGION AUTHORITIES

Name of local authority..
Population..
Is your district in a designated "black area?"

1. What was your council's programme as submitted to the Minister of Housing and Local Government in accordance with *Circular* 5/59

1	2 1958	3 1959	4 1960	5 1961	6 1962	7 1963	8 *Final Objective*	9 *Target year for completion*
Premises								
Dwellings								
Acres								

2. What progress had been made up to 31.12.61?

1	2 1958	3 1959	4 1960	5 1961
Premises				
Dwellings				
Acres				

3. What was your council's revised programme as submitted to the Minister of Housing and Local Government in accordance with *Circular* 4/62!

1	2 1961	3 1962	4 1963	5 1964	6 1965	7 1966	8 *Final Objective*	9 *Target year for completion*
Premises								
Dwellings								
Acres								

4. What progress had been made up to 1.8.1963?

1	2 1961	3 1962	4 1963
Premises			
Dwellings			
Acres			

5. Have any Orders (as tabled in question 4) been submitted to the Minister but not confirmed as a result of shortage of open fire coke? (See para. 7 of M. of H. & L.G. letter dated August 1, 1963)..

6. If answer to question 5 is yes, how many orders, premises, dwellings and acres are involved:
Orders ....; Premises ....;
Dwellings ....; Acres...........

7. What is your average cost per fireplace of conversion or adaptation in areas so far brought into operation?
£..

8. What is your *estimated* average cost per fireplace conversion to hard coke burning appliances? (See para. 10 of M. of H. & L.G. letter dated August 1, 1963) £..

9. Does your council intend to continue, modify or suspend its programme as tabled in question 4? Please give brief details:

10. Please indicate the estimated percentage of acceptance by householders in your area of conversions to:
(*a*) Room heaters ....
(*b*) Gas fires ....
(*c*) Oil fires ....
(*d*) Electric heat storage appliances ....
(*e*) Central heating ....

11. Please give your assessment of public opinion in your area towards smoke control areas generally; (place tick opposite appropriate description).
(*a*) Very favourable
(*b*) Favourable
(*c*) Non-committal
(*d*) Unfavourable
(*e*) Actively unfavourable

12. If smoke control area progress in your area is suspended or delayed, to what do you ascribe this development: (please tick which)
(*a*) Resistance to smoke control in principle
(*b*) Increased financial expenditure involved

13. Additional comments (these are welcomed)

YORKSHIRE

by A. C. Saword, D.P.A., F.R.S.H., F.A.P.H.I.

Programmes of Local Authorities

THE programmes of all local authorities in black areas within the division are set out in the Appendix to this report and it will be seen that substantial progress has been made. This progress has not, however, been shared equally between all the authorities; some have achieved more than 30 per cent of their target while others have made a mere token start or even failed to submit a programme. Amongst the authorities that have made most progress, in terms of percentage of target achieved, are Aireborough (32 per cent acreage, 35 per cent premises); Kingston upon Hull (40 per cent acreage, 28 per cent premises) and Sheffield (35 per cent acreage, 23 per cent premises). Bradford, in addition to having 22,273 premises within operative smoke control orders, has over 14,000 Corporation-owned houses rendered smokeless as the result of tenancy agreements and local smokeless zone powers. Leeds, Halifax, Brighouse, Doncaster, Rotherham, Shipley, Knottingley, Ossett and Morley have all made excellent progress and other authorities are keeping abreast of their programme commitments.

The figures in the Appendix were supplied mainly by the Society's Headquarters and show the position up to April 1, 1964. In July of this year the Yorkshire Divisional Council sent out a questionnaire to all authorities in the division with the object of ascertaining the latest position and in a few cases the headquarter's information has been amended in the light of replies received. The main purpose of the questionnaire was to find out what the Yorkshire authorities had done since our last conference, in October, 1963. At that time the position regarding smokeless fuel supplies was very much in doubt and the Ministry had not announced its proposals for meeting the situation, consequently some local authorities were deferring action pending further information. The White Paper on Domestic Fuel Supplies and the Clean Air Policy (Cmnd. 2231) and Circular 69/63 were published in December, 1963, and the seven months that had elapsed before the questionnaire was sent out should have been sufficient to enable local authorities to reach a decision on future policy. One section of the questionnaire, intended for authorities in black areas who have submitted programmes, was as follows.

	Replies Received	
	Yes	*No*
Has your Council, since October, 1963—		
(*a*) Abandoned its programme of smoke control	—	37
(*b*) Deferred the 1964 or 1965 instalment of its programme	10	27
(*c*) Decided to revoke (subject to necessary legal procedure) any existing smoke control order	—	37
(*d*) Speeded up its smoke control programme	1	36
(*e*) Re-affirmed its intention to proceed according to its programme as published in Cmnd. 1890	14	23

Of the ten authorities (4 county boroughs, 3 boroughs and 3 urban districts) that deferred an instalment of the programme, one has now given instructions for surveys to proceed on an area of smaller size than originally planned in order to keep the cost under the revised grant arrangements within the limits of the origina scheme. Another deferred an order that was about to be made just before the change in grant procedure was announced, so as not to be halfway through the work when the changes occurred, but they have every intention of proceeding with their programme under the new rules. A third authority postponed the operative date of an order that had already been made but declared their intention of proceeding with further areas in accordance with their programme. It will be observed from the above replies that no authority has abandoned its programme or decided to revoke any existing Order. The remaining deferments are apparently only temporary. One urban district had speeded up the work by the appointment of a special smoke control officer.

The questionnaire also sought to find out the latest possible information concerning areas that are not yet operative but are in the pipeline, as this gives a good indication of any recent change of policy. It showed, for example, that Sheffield has a further 14,321 premises in areas confirmed but not yet operative, and 12,273 premises covered by orders awaiting confirmation by the Ministry. The Sheffield Council were still making orders as fast as the areas could be surveyed and their latest order has been made only a few weeks before the questionnaire was returned. Leeds had 8,510 premises in the pipeline and their latest order was made on May 6, 1964. It is therefore plain that the two largest cities in the division are going ahead with all possible speed. Twenty other black area authorities had a combined total of 34,119 premises covered by smoke control orders that had been made recently and were not yet operative. Altogether 21 authorities in black areas within the Yorkshire Division are known to have made smoke control orders between July, 1963 and July, 1964.

The Yorkshire Division of the Society does not include the industrial area around Tees-side, which is attached to the North-East Division, but it does include many districts such as the Yorkshire coast resorts, the wolds and the dales which are not black areas. Some of these last mentioned districts are, however, anxious to add brightness to whiteness and Skipton Urban District Council already have 370 premises covered by operative orders and a further 558 premises awaiting confirmation by the Ministry: their latest order was made on January 1, 1964. Saddleworth U.D., Todmorden B., and Wortley R.D. are other "white" areas with smoke control programmes, the number of premises they have already within operative areas totalling 2,764. Todmorden has another 650 premises in the pipeline and made their latest Order in January, 1964. Harrogate has not yet made any smoke control orders but the majority of hotels and large boarding houses have smokeless methods of heating for reasons of economy and convenience, and Mr. Dodsworth reports that a tremendous amount of work has gone on voluntarily in domestic premises, especially conversion to gas and electricity.

Public Opinion

To assess public opinion in a large area like Yorkshire is not easy as there is such a wide variety of conditions and interests. The progress being made in Sheffield, Leeds and other industrial centres in the West Riding is sufficient proof that in those districts there is strong support for smoke control—both from the public and from the Councils. Indeed, Mr. James Goodfellow reports that the citizens of Leeds, in nearly every ward of the city, are calling for smoke control to proceed at a faster pace. He attributes this well-informed public opinion largely to the continuous activity of the Yorkshire Divisional Council of the Society and to the very helpful publicity the local press accord to the subject of clean air. Last year there was a particularly effective double-column report and an editorial in the Yorkshire Post arising from the Leeds Health Committee's annual tour of inspection, which included a visit to the Thoracic Surgery Department of the Leeds General Infirmary. Members of the Committee were shown samples of human lungs blackened by atmospheric pollution and the senior registrar produced "a lot of evidence to show how Leeds air kills people".

On the other hand, reference to the Appendix to this report or to Cmnd. 1890, will show there are 15 small authorities in black areas in Yorkshire who have not submitted a programme of smoke control. At first thought it might appear that they are not very interested in clean air but the position is not as simple as that. Many of these districts are predominantly mining districts and the issue is obscured by problems concerning concessionary coal. Although agreement has been reached at national level between the N.U.M. and the N.C.B. the terms are not acceptable to everyone. Briefly, if a mineworker's house is brought within a smoke control area he will be allowed supplies of solid smokeless fuel up to the value of £47 12s. per annum, or possibly cash, in place of his concessionary coal but there still seems room for argument as to whether this equals the money value of his concessionary coal. Mr. Winfield tells me the Coal Board are prepared to extend these arrangements to miners who wish to turn to solid smokeless fuels for background heating from independent boilers or openable stoves whether or not they are in smoke control areas. This is an excellent move on the part of the N.C.B. and is likely to attract the miner by giving higher standards of heating which many will be glad to adopt voluntarily. Once they show the way, others will follow in order to keep up with the Joneses.

In the East Riding, Kingston upon Hull is the only classified black area and public opinion within the city seemed at first to be strongly in favour of clean air. Facts should speak louder than words and it is a fact that 40 per cent of the area of the city has been covered by ten smoke control orders since July, 1958, and not a single formal objection was made by any of the owners or occupiers of the 29,245 premises involved. They all received prior notification of the Council's proposals and a mere postcard to the Ministry would have been sufficient to lodge an objection. Moreover, persons affected by the tenth order had seen the results of the first nine orders and had four years to think it over before their turn came, but still they did not object. On the contrary, many welcomed the order so much that they caused legal and financial difficulties by getting on with conversion work before the order was confirmed!

Nevertheless it must be admitted that there have been a number of critical letters in the local press and a number of complaints to members of the Council. Very few complaints were made direct to the public health department and these were greatly outnumbered by letters of appreciation and enquiries from people hoping their district would be dealt with at an early date. Among the complaining letters were some written by people not living within smoke control areas and their interest in the matter may not always have been as simple as it seemed. Smoke control does, of course, affect the business of some people such as chimney sweeps, coal merchants, firewood dealers, etc. The total number of critical letters published over several years amount to only a few dozen and these have to be viewed in the light of the thousands of premises involved. The main criticism was against solid smokeless fuels on the grounds of alleged high price and shortage of supplies, and against gas-coke in particular on the grounds of "fumes" and difficulty of ignition.

Smokeless Fuel Supplies

The Yorkshire Divisional Council of the Society includes representatives of all the fuel industries and the present position may be summed up as follows:

(*a*) *Solid Smokeless Fuels*. The National Coal Board produces a number of solid smokeless fuels including Anthracite and Dry Steam Coal, Phurnacite and Sunbrite, all of which are available for supply in Yorkshire for domestic use in Smoke Control Areas. Mr. M. B. Allan, the Board's Deputy Marketing Director for the Division, points out that Sunbrite is made locally in large quantities and as it is suitable for use in closed and openable stoves, room-heaters and also a large number of underfloor draught fires, it is the Board fuel mainly used in this Region. Additionally, the Board is in process of providing a new smokeless fuel, Roomheat, a fluidized briquette, and again this will be made locally, small quantities being available this winter and production at the rate of 100,000 tons per annum by the winter of 1965/66. Roomheat is suitable for burning in roomheaters, and on underfloor draught and improved open fires.

Mr. H. Giblin, Manager, Solid Smokeless Fuels Federation, informs me that solid smokeless fuels suitable for use on the approved open fire will continue to be made available for all existing Smoke Control Areas. For the establishment of future Smoke Control Areas there will be sufficient smokeless fuels. The position will vary a little from locality to locality but sufficient fuel of most types will be available to fulfil requirements, particularly if Smoke Control Areas are established on the basis of freedom of choice.

(*b*) *Gas Coke*. Mr. K. E. Laycock, Coke Officer of the North-Eastern Gas Board states that the new methods of gas production which use feedstocks other than coal, and therefore, do not have the associated coke are now coming into production. This means that in the West Riding there will be a gradual reduction in the amount of gas-coke produced over the next two or three years. Supplies of open fire gas-coke will be available for all those areas which are at present under smoke control orders, or have been given guarantees of open fire coke, but it is no longer possible to guarantee additional supplies of open fire coke for future smoke control areas. In Hull supplies of open fire coke are assured for the present smoke control areas and also for the proposed No. 11 Order.

(*c*) *Gas*. Mr. Norman Hudson, Commercial Manager, North-Eastern Gas Board, reports that whilst originally it was anticipated that the bulk of householders would opt to change over to solid smokeless fuels, and indeed the grant favoured such conversions, recent experience has shown that a large number of householders are forsaking solid fuel in favour of gas or electricity, and it would appear that this trend is accelerating rapidly. As one indication of the overall progress in this sphere the sale of gas room heaters for main living rooms has multiplied year by year and is now running at approximately 400 per cent over the annual rate of 1960.

This trend appears to be equally applicable to existing houses as it is in the new dwellings now being erected.

All action necessary to ensure adequate gas supplies to meet all present and likely additional demands for gas in the future is now being taken.

(*d*) *Electricity*. The position regarding electricity will apparently be governed by the policy laid down in Circular 69/63 and householders should be "encouraged" to install thermal storage space-heaters which take power on off-peak tariffs. For the present, householders should be discouraged from installing with the aid of Clean Air Act grant, all forms of electric space-heaters other than storage heaters.

(*e*) *Oil* is undoubtedly gaining in popularity and there are no difficulties concerning supply.

Conclusion

Smoke control suffered a slight set-back in Yorkshire as the result of the uncertain fuel situation which developed in the autumn of 1963. This was not sufficient to cause any authority to revoke its programme although a few deferred action. The majority of authorities are going ahead with smoke control and are making very satisfactory progress. The wider choice of fuel-burning appliances eligible for financial grants under the new rules is generally welcomed, and in particular, gas appliances, underfloor draught fires and glass fronted room heaters are gaining in popularity. There is disappointment among some sections of the public over the continued shortage of the more highly reactive solid smokeless fuels and the restrictions on direct space-heating electrical appliances. There is also a feeling that progress with smoke control would be made easier by a more positive and co-ordinated policy on the part of the government and the fuel industries. At the same time it is recognized that the government has, by its recent changes of policy, provided most of the tools required and it is now up to the local authorities to get on with the job. A good workman never blames his tools.

APPENDIX

Programmes of Local Authorities in Black Areas within the Yorkshire Division (excluding Tees-side)

Authority	*Target Date*	*Target*		*Achieved*	
		Acreage	*Premises*	*Acreage*	*Premises*
Aireborough U.D. . .	1970	6,856	9,335	2,180	3,287
Baildon U.D.	1970	2,830	4,500	1,112	1,217
Barnsley C.B.	1981	7,811	27,023	414	954
Batley B.	1977	4,461	16,700	490	3,243
Bingley U.D.	1970	11,418	9,412	1,437	3,222
Bradford C.B.	1975	25,503	121,177	4,194	22,273
Brighouse B.	1975	7,875	14,200	1,755	2,696
Cudworth U.D.	1975	1,746	3,000	—	—
Dewsbury C.B.	1975	6,720	13,150	232	2,498
Doncaster	1970	8,371	30,000	1,396	5,795
Elland U.D.	1978	5,951	8,598	30	423
Halifax C.B.	1977	14,081	42,297	1,635	7,960
Heckmondwike U.D. . .	1970	697	4,000	166	588
Horbury U.D.	1969	1,280	3,345	—	—
Horsforth U.D.	1968/70	2,706	6,194	285	561
Huddersfield C.B. . .	1980	14,147	55,488	1,621	3,875
Keighley B.	1970	3,238	16,511	250	5,014
Knottingley U.D.	1969	2,837	5,350	412	1,400
Kingston upon Hull . .	1971	12,000	103,951	4,848	29,245
Leeds	1975	40,613	201,000	2,296	27,139
Mirfield U.D.	1979	3,394	5,147	274	823
Morley B.	1977	9,529	17,243	2,545	2,955
Normanton U.D.	1977	3,061	—	—	—
Ossett B.	1969	3,332	6,150	424	1,869
Pontefract B.	1979	4,865	9,000	611	802
Pudsey B.	1980	5,205	12,545	16	505
Queensbury & Shelf. U.D.	1975	2,795	3,778	455	898
Rotherham C.B.	1973	8,000	28,000	1,068	5,234
Rothwell U.D.	1971	10,695	—	195	645
Sheffield C.B.	1972	39,598	184,600	14,017	42,571
Shipley U.D.	1974	2,184	11,500	774	2,853
Sowerby Bridge U.D. . .	1973	5,763	6,500	—	—
Spenborough B.	1972	8,253	15,030	1,452	2,631
Swinton U.D.	1973	1,718	4,553	—	—
Wakefield C.B.	1977	5,800	22,506	614	1,638
Wath-upon-Dearne U.D. . .	1972	2,665	5,500	10	641
Worsborough	1976	1,660	4,640	—	—
Totals		299,658	1,031,923	47,208	185,455

WEST MIDLANDS

by W. L. Kay, F.A.P.H.I., M.R.S.H.

THE Minister of Housing & Local Government stated in Parliament on May 24, 1963, that in view of rapid technological changes in the gas industry affecting the production of gas coke an immediate review of current arrangements under the Clean Air Act, 1956 was being instituted. This review led to the issue in December last of Circular No. 69/63 on Smoke Control Areas and the White Paper (Cmnd. 2231) Domestic Fuel Supplies and the Clean Air Policy.

The effect of the issue of these documents was to cause local authorities to re-examine their smoke control area policy.

In order to obtain a picture of the general situation throughout the country arising out of this re-examination of policy, the Conference Committee decided to ask the divisions to report on the position in their areas.

The method used to obtain this information in the West Midlands was to circulate a questionnaire (Appendix 'A') to all the constituent local authorities within the Division, rather than restricting it to the black areas. The reason for this decision was due to the fact that there is no precise definition of a "black area" and it is considered that the amount of domestic coal burnt per acre is the significant factor. Of the 41 authorities written to, 36, *i.e.*, 87·8 per cent replied. 14 authorities, *i.e.*, 38 per cent of those replying reported that at the time of the circulation of the report, no smoke control orders were operative in their area. Various reasons are given for this inaction. The common reason is the lack of availability of suitable solid smokeless fuels. This type of reply had been anticipated and a questionnaire (Appendix 'B') was circulated to the Regional Coke Manager of the West Midlands Gas Board, the Director of Marketing National Coal Board, Midlands Regional Sales Office, and producers of premium grade smokeless fuels.

The West Midlands Gas Board reported in answer to question 3(a), *i.e.*, present availability of fuel, "Anticipated total production 1964/1965—850,000 tons, of which 470,000 tons will be Gloco". They further state that they are confident that for the foreseeable future they will be able to supply as much open-fire coke for sale as the markets in the Midlands can absorb. They point out that gas production methods are so flexible that coke production can be increased or decreased at will according to the demand for coke. The Coal Board state that "Adequate supplies of Sunbrite are, and will continue to be, available for any new smokeless zones which are likely to be proposed in the foreseeable future and that by the winter of 1965/1966 substantial supplies of Homefire will be available."

One of the premium fuel producers stated that they were unable to divulge production figures, but had adopted a progressive policy of increased production. The other firm gave a tonnage availability figure of 200,000 tons domestic size for England and anticipated increases of 125,000 tons from September, 1965, with a similar increase in 1966.

The returns received from the local authorities who have smoke control orders in operation were most informative. To question (1) *on the state of public opinion* the replies generally indicate that whilst there is no great enthusiasm amongst the public, the position is accepted and there is no serious opposition.

The answers to Questions 2 and 3 reflect the present attitude of the local authorities in the light of recent changes in Government policy. Quite a number of replies indicate that they are proceeding with caution in view of present conditions.

Of the 22 authorities with smoke control areas in operation, 6, or 27·2 per cent are continuing with their programmes unabated; 11, or 50 per cent have cut back their programmes and the remaining 5, or 22·8 per cent have halted their programme.

The main reasons given for retarding or halting existing programmes are (1) uncertainty about supplies of solid smokeless fuel and increased costs of conversion work (seven authorities gave this as their reason). (2) Staffing difficulties (four authorities made this point).

On Question 4, all but two of these authorities had considered the implications of the White Paper and arrived at decisions. Twelve authorities have decided to follow the guidance set out therein and 8 have decided to adhere to their original practice, chiefly because of assurances of adequate supplies of soft coke or, alternatively, because having halted their programme, they feel that the White Paper is inapplicable to their area.

In view of the change of policy at national level as outlined in the White Paper, the success of which will depend largely on the public's acceptance of solid fuel roomheaters in place of open fires and of gas roomheaters, oil heaters, electric thermal storage heaters, and central heating, authorities were asked to state the proportion of these types of heaters in their latest Smoke Control Area. 16 of the 22 authorities (approx. 72·7 per cent) provided this information.

With one notable exception, where a figure of 46 per cent was given, the proportion of solid fuel roomheaters installed varied between nil and 10 per cent. Figures given for gas room heaters showed the remarkable swing to gas ranging from 4 to 45 per cent.

Table 1: Summary of Replies received to Question 5(b)

Percentage of Gas Room-Heaters in latest Smoke Control Area	*Number of Authorities*
Nil—10	3
11—20	4
21—30	4
31—40	3
41—45	2

So far as oil heaters are concerned, only 6 authorities reported the installation of oil heaters which, with one exception, ranged from 0·2 to 1·0 per cent. The exception gave a figure of 9 per cent.

The relative newness of electrical thermal storage heaters probably explains the low figures, 11 authorities making a nil return and the remainder giving figures varying between 0·05 and 1·6 per cent.

Whilst not quite as attractive as gas roomheaters, nevertheless the popularity of the direct-acting electric fire is quite clearly demonstrated by the figures given in Table 2 and in view of electric supply difficulties, proves the soundness of the view expressed in paragraph 28 of the White Paper.

Table 2: Summary of Replies received to Question 5(e)

Percentage of Direct-Acting Electric Fires in latest Smoke Control Areas	*Number of Authorities*
Nil—10	11
11—20	3
21—30	—
31—40	2

No less than 12 authorities reported the installation of central heating in their latest Smoke Control Area, the proportion varying between 0·25 and 5 per cent.

It will be recalled that in his address at the conclusion of the Society's Annual General Meeting in London on April 14 this year, Sir Keith Joseph, Minister of Housing and Local Government, said "*There is after all a great tide of people outside smokeless zones who are voluntarily, because either of convenience or of increased heating efficiency and entirely* *at their own cost, doing what some people sometimes complain at being asked to do at only a cost of 30 per cent within the smokeless zones*".

In an attempt to assess the strength of this movement, local authorities were asked to state to what extent the voluntary installation of the appliances listed in Question 5 was helping smoke control. The replies (14) received to this question are set out in Table 3.

Table 3

(*a*) Not at all	4	(28·6% approx.)
(*b*) One room per house	5	(35·7% approx.)
(*c*) More than one room per house	5	(35·7% approx.)

The effect of the changed policy on the achievement of Clean Air is shown in Table 4 below.

Table 4

Summary of Replies to Question 7, re Target Dates

Target date extended	5 authorities
Target date unchanged	9 authorities
Decision not yet reached	7 authorities
Target Date not fixed	1 authority

Because of the anxiety evident in so many quarters as to the adequacy of smokeless fuel in its various forms, it was decided to send the questionnaire (Appendix 'B') already referred to, to the Midlands Electricity Board and the Manager of the Midlands Division of Shell-Mex and B.P. Ltd., in addition to the solid fuel producers previously mentioned.

It appears appropriate to confine comment to the answers to questions 3 and 4. So far as the solid smokeless fuel producers are concerned, question 3 has been largely dealt with. Shell-Mex and B.P. Ltd., appear confident that the oil industry with its ability to move supplies to meet demand would be in a position to meet any likely requirements of Smoke Control Areas and they do not anticipate any shortage of oil supplies within the foreseeable future. They point out that supplies being geared to an international production network are capable of meeting any increase in demand at one point of the chain, i.e., the United Kingdom.

To question 4, asking if the position in the Midlands differs materially from the rest of the country, they state that the industry is organized on a national basis and, therefore, as and where demand occurs so supplies will be available.

The Midlands Electricity Board anticipate an increase in production at the rate of 7 per cent per annum and state that the fuel position in the Midlands does not differ materially from the rest of the country. In reply to question 4, the West Midlands Gas Board comment "This Board is the only one which solely produces C.V. Coke, which is the most suitable for the domestic open-fire market". Both the producers of premium smokeless fuels are of the opinion that the fuel position in the Midlands does differ materially from other parts of the country and give as the reason the situation of the Collieries.

APPENDIX 'A'

QUESTIONNAIRE TO LOCAL AUTHORITIES

1. What is the state of public opinion in your area concerning smoke control?
2. What is the present attitude of your authority?
3. Is progress
   (*a*) continuing unabated
   (*b*) retarded
   (*c*) halted
4. To what extent is your authority following the guidance outlined in the White Paper as to
   (*a*) Fuel
   (*b*) Appliances
5. What is the proportion of the following heaters in your latest Smoke Control Area?
   (*a*) Solid fuel room heaters (i.e., openable stoves)
   (*b*) Gas room heaters
   (*c*) Oil heaters
   (*d*) Electric thermal storage heaters
   (*e*) Direct-acting electric fires
   (*f*) Central heating

6. To what extent is the public demand for clean and convenient heat helping smoke control by the voluntary installation of one or other of the appliances listed in (5) above.
   (*a*) not at all
   (*b*) one room per house
   (*c*) more than one room per house
7. In view of the changed circumstances occasioned by the White Paper, what is the revised target date for achieving complete smoke control in your area?

Acknowledgments

I wish to express my thanks to Mr. S. Cayton, Chief Public Health Inspector of West Bromwich, who co-operated in the preparation of the questionnaires. My thanks are also due to those who completed the questionnaires and thus made this paper possible.

APPENDIX 'B'

QUESTIONNAIRE TO FUEL PRODUCERS

1. What is the state of public opinion in your area concerning smoke control?
2. To what extent is the public demand for clean and convenient heat helping smoke control by the voluntary installation of one or other of the following appliances: Solid fuel room heaters (i.e., openable stoves); Gas room heaters; oil heaters; Electric thermal storage heaters; Direct-acting electric fires; Central heating:
   (*a*) not at all
   (*b*) one room per house
   (*c*) more than one room per house
3. (*a*) What tonnage of your fuel is now available?
   (*b*) For how many years can such availability be guaranteed?
   (*c*) Do you anticipate an increase or decrease in production in the foreseeable future and will you please state the percentage increase or decrease?
4. Does the fuel position in the Midlands differ materially from the rest of the country and, if so, why, and to what extent.

EAST MIDANDS

by G. A. Hiller, F.R.S.H., F.A.P.H.I.

WITH the publication of the Ministry of Housing and Local Government Circular No. 69/63 entitled "Smoke Control Areas" and dated December 17, 1963 considerable apprehension was felt in local authorities in the Division and particularly amongst the officers responsible for the administration of the Clean Air Act, 1956.

Concern stemmed from the fundamental changes which were envisaged involving largely the abandonment of the traditional open fire, as well as problems of cost.

Previously it had been a strong point to make in favour of domestic smoke control that the open fire could still be enjoyed by the householder together with some increase in heat output as well as making an individual contribution towards a cleaner atmosphere. Generally speaking when solid smokeless fuel was to be used for space heating it was to be burned on an open grate. Moreover it was understood that this Division was more favourably placed than other parts of the country in the availability of gas coke. This has proved to be not so.

In an endeavour to get some uniformity of outlook the public health inspectors held a meeting called by their Association which was exceptionally well attended and which was considered by all to be most helpful. It was clear that the officers were determined that as far as was in their power smoke control programmes would continue to go ahead.

Since this meeting regret has been expressed that local authorities have not yet received any guidance as to the appliances they should in future install in their own dwellings.

The extension of credit facilities has been found to be helpful.

Opinion in the Division

Public opinion has been little influenced by the changed situation; indeed it might well be said that public opinion is ahead of the local authorities when one looks at the undoubted boom that exists in the sale of the new attractive glass fronted solid fuel room heaters, gas fires, and electric storage heaters. After all the individual can always get ahead if he wishes! Particularly is this so in the southern half of the Division.

Householders are looking to their house warming and hot water arrangements or rather the lack of them and by means of the new appliances are increasing and extending their space heating by means of radiators. Improved appearance and performance in appliances together with keen competition amongst the fuel suppliers have brought this about and in consequence smokeless fuels are being used more and more with smoke reduction as a result.

Vendors of all types of improved heating appliances report increased sales.

Local authority opinion overall is in favour of continued smoke control procedure in accordance with approved programmes. Sufficient has been done in the larger centres of population to demonstrate the effect and the value of what was done earlier.

Unhappily in parts of Derbyshire and Nottinghamshire two local authorities in the black areas have actually persuaded the Ministry of Housing and Local Government to authorize the suspension of existing confirmed Orders, some of which have been in operation for several years whilst another has asked the Minister to revoke an Order because of alleged hardship. In the former cases reasons stated are—non-availability of suitable fuels, their ineffectiveness in providing sufficiently for space heating and domestic hot water, and the effectiveness of the approved appliances in themselves. The Coal Utilisation Council is conducting an inquiry on behalf of one of the Councils concerned.

Another local authority in the neighbourhood although not regarded as 'black' has also had suspended an Order which would have come into force on August 1, 1964.

In all, over 5,000 premises are involved in towns situated in coal mining areas so that it seems only fair and factual to say that the vexed question of the miners concessionary fuel allowance is not yet settled satisfactorily despite the national agreement arrived at some years ago.

The ultimate decisions of these local authorities and indeed of the Ministry after full investigation will be awaited with interest.

Some of the smaller authorities have expressed their fears at the increased cost of clean air.

On the brighter side of the picture we see Councils not regarded as being in the black areas going ahead with smoke control programmes which now cover over 13,000 premises. In some cases there is commendable cooperation between county boroughs and their rural district neighbours where fringe areas are concerned.

Summing up

To sum up the public viewpoint, smoke control is accepted as desirable and indeed essential but there would be more enthusiasm if it were not for the relatively high cost of the solid smokeless fuels when compared with coal. A particular grievance is that whilst we are told of vast supplies of hard coke (Sunbrite) that are available it has not been found possible to offer a special summer price to those who have room to lay in a store for the winter.

Future Trends

As to the future the prospects of a clean atmosphere would seem to be good for whilst a few authorities have not given a date, or else have fixed a positively "long-term" date for the completion of their Smoke Control Areas programmes, the years 1970 to 1975 will see completion in most of the larger centres of population in the black areas.

All this of course is the approach of "officialdom" which reckons without the wind of change regarding home heating generally.

During the next decade young married couples will opt largely for smokeless heating without the inconveniences associated with solid fuel and will be demanding a degree of comfort which is only just beginning to be realized as being possible in this country so that as time goes on apart from those towns having special problems of their own, smoke control should become easier and ultimately taken for granted.

SOUTH WEST

by G. W. Dhenin, M.R.S.H., M.A.P.H.I.

Introduction

THE South West Division of the Society, comprising the counties of Gloucester, Somerset, Wiltshire, Dorset, Devon and Cornwall, with some 200 local authorities, includes very few large conurbations and these are found around the two main ports, Bristol and Plymouth, and to a lesser extent at the multitude of holiday resorts around the coasts where high density housing and occupation is not usually the case particularly in the "heating" season.

Fortunately for those privileged to live in the South West there is no very large scale industrial pollution and, except for the North Somerset coalfield there is no extensive mining of bituminous coal.

Smoke Control Areas

As a result direct of the foregoing there has been no general effort in the Division, except from a few progressive local authorities, either to stimulate interest in or to take firm steps to establish smoke control areas.

An 80 per cent return of questionnaires from over 50 local authorities selected on a geographical basis, show that in very few cases there was definite antagonism to smoke control both in the area and in the Council. Most replies indicated apathy, while in ten areas only was there marked interest. Only five authorities, namely, Bristol, Cheltenham, Exeter, Gloucester and Kingswood, have established smoke control areas comprising in total eighteen areas, amounting to 6,150 acres with some 23,350 premises. No great difficulties were reported by these authorities in putting through the smoke control areas due, no doubt, to first class preliminary work and public relations. Some opposition from coal merchants in the earlier days did not recur.

An additional four areas with nearly 9,000 premises have been proposed for 1965/66 but it seems that progress will be halted in two cases by reason of Circular 69/63. Some local authorities have not even adopted the Clean Air byelaw for new buildings under Section 24 of the Act.

From the D.S.I.R. Atmospheric Pollution Bulletins it appears that over 22 local authorities in the South West, operating nearly 70 sites with either volumetric instruments, lead dioxide and deposit gauges, regularly forward monthly figures to the Laboratory at Warren Spring. While this shows some interest, most of the sites, it must be admitted, were selected as checks on industrial and commercial pollution.

Availability of Fuels

Enquiries as to the availability of smokeless fuels in the Division indicate that the "piped fuels" are readily available throughout the region with perhaps some slightly temporary difficulties with gas supplies in the far west of Cornwall and in one or two rural areas where it also seems that premium fuels, by reason of transport and geographical problems, are not so forthcoming as elsewhere. No shortage is contemplated for many years in hard coke or Gloco, while the supply of electricity poses no problems for the area as a whole either as a direct supply or for "off peak" use.

Fuel merchants and their associations in the South West generally appear to be progressive and are changing their outlook to meet the present requirements of consumers. Complaints of merchants deliberately opposing smoke control areas or providing difficulties in the supply of approved solid fuels in such areas have long since disappeared.

The sale of prepacked fuels has gone ahead in most parts of the region but in many cases consumers have not been afforded practical protection against fraud. Prepacked containers, in my view, should be marked with the description of the fuel, group number where applicable, nett weight, name and address of packer and, where possible, the recommended selling price.

The rising cost of solid smokeless fuels is causing some concern. An increasing financial burden is being placed on consumers who use these fuels by preference and who have in many cases installed approved solid fuel appliances although not in an official smoke control area. It seems equitable that there should be made possible by a national fuel policy, a reasonable choice of smokeless fuel for open fires at a fair price and available in all parts of the country.

The national drive against domestic smoke has recently taken something of a knock because a new basic plan has had to be adopted in place of the original one in which the main burden of the changes to be made in domestic smoke control had rested on open fire coke. This new plan, involving the production of cheaper gas by the total gasification of coal, methane gas or oil distillates, will eventually provide a more competitive available "piped" fuel but with the short term result of increased cost to householders and to local authorities in establishing smoke control areas where problems in the availability of some smokeless solid fuels may necessitate the installation of the more costly type of room heaters. Alongside this must be set the greater efficiency of such appliances providing the right type of solid fuel is available.

The erection of the new plant at Avonmouth for the production of gas from coal, oil, Sahara gas, etc. without the usual coke by-product, has already commenced, but I am informed that adequate supplies of open fire coke, Gloco, etc. are assured in the South West for the next seven years at least.

Approved Appliances

From the replies received no marked preference can be established for the various types of approved heating appliance. The new solid fuel room heaters seem quite acceptable, also the use of off-peak heating by electricity for background heating with the new and more refined looking block appliances. The installation of full or partial central heating is on the upgrade in all parts with solid fuel, gas and oil fired boilers equally acceptable. A slight trend towards the diminishing use of free standing oil heaters could be detected.

Summarizing, it seems that only a few local authorities in the South West have shown interest in domestic smoke control. A great deal of the burden of information, publicity and advice on smoke control in the northern part of the region has been accepted and carried out by the Bristol and West Clean Air Committee, a body which functions among local authorities within a forty mile radius of Bristol. A debt of gratitude to the Committee and to the late F. J. Redstone, its Honorary Secretary for many years, is acknowledged by those in the South West who have Clean Air at heart. A mere fifteen Councils in the Division claim membership of the National Society.

It is accepted that the problems in domestic smoke control in the South West are not as urgent or pressing as those in the "black areas" but there is now an excellent opportunity for progressive local councils to take advantage of the Ministry's attitude of encouragement to commence a programme by which the end of domestic smoke in their areas can be anticipated within the next fifteen to twenty years.

Acknowledgments

Thanks are extended to those authorities whose officers completed and returned the Questionnaires:

The Bristol and West Clean Air Committee under whose aegis the report is prepared, and

The Information Officer of the National Society for Clean Air.

SOUTH EAST

by J. S. Hodgins, M.R.S.H.

Introduction

THE object of this report is to try to assess the general situation in the South East Division as a result of the recent changes arising from Circular 69/63 and the White Paper on Domestic Fuel Supplies.

Questionnaires, 97 in all, were sent out to all the "black area" authorities in the Division except those whose Smoke Control programmes were completed, and to other local authorities in the Division known to be carrying out smoke control although not designated as black areas. The number of completed questionnaires returned was 75 and statistically these form the basis of this report. My thanks are due to those officers who took the trouble to compile the required information.

As the report had to be submitted to the Society by the end of July the information in it was collected during May and June.

The Background

In the middle of December 1963, smoke control in the South East could have been said to be in a comparatively healthy condition. The establishment of smoke control areas was progressing steadily, the percentage of premises in smoke control areas measured against final target figures was, at approximately 40 per cent far in excess of any other region; only four black areas in the region had not submitted programmes (against 48 for the rest of the country); the only three black areas in the country to have completed their programmes were in the South East, 46 black areas in the region had target dates not later than 1970 against only 50 for the rest of the country; and there was no serious overall shortage of solid smokeless fuel.

True, an ominous cloud had been visible for some time on the north eastern horizon but as it appeared to be relatively stationary, life in the South East (apart from those areas affected by local government reorganization) followed its normal placid course.

The Circular—and resulting changes

Circular 69/63 issued on December 17, 1963, changed all this overnight. It was officially admitted that the expected increase in the production of gas coke, the recognized mainstay of Smoke Control Areas, would not take place and local authorities were told that the full expenditure on expensive appliances such as electric thermal storage heaters, gas room heaters, underfloor draught grates and inset and free-standing stoves should be eligible for grant so as to encourage the use of fuels which were in good supply.

The Benefits

The clean air enthusiast saw in these changes the possibility of a substantial reduction in the emission of sulphur dioxide from domestic chimneys. The widespread use of gas and off-peak electricity, completely free from smoke or sulphur, was bound to have a marked and beneficial effect on the level of pollution. To a lesser degree the increased use of inset or free-standing stoves with nearly treble the efficiency of the improved open grate would have the same effect—provided of course that the users were merely satisfied to have the same amount of heat as they previously obtained from their open fire. One suspects however that it will become common practice to run radiators off these appliances and obtain a far greater degree of comfort from the same amount of fuel used.

The Cost

To Chairmen of Finance Committees the picture seemed rather different. These changes would cost money—a lot of money. The cost of smoke control would increase, not fractionally, but substantially. The question is, is it worth it?

The advantages of the changes, as I see it, are these:

(*a*) The more people who can be encouraged to install gas and electric heaters, the more solid smokeless fuel there will be for those who still wish to use it.

(*b*) Householders who go over to gas and electricity will get their heating in its most labour saving form, free from any storage and delivery difficulties, and will not pay appreciably more for heat than they would from an open fire.

(*c*) Householders who install inset or free-standing stoves will give themselves a standard of comfort far in excess of what is possible from an open fire, at no extra cost for fuel.

(*d*) The beneficial effect on the level of pollution could be substantial, especially sulphur dioxide pollution.

The Effect on the Smoke Control Programme

Any public health measure, however worthwhile, and indeed any form of social reform is vulnerable to financial considerations and inevitably these changes took their toll. It is with regret that I have to report that two Local Authorities in the region have suspended their smoke control programmes and a further nine have slowed them down, but only temporarily, it is believed, in some instances. The increased costs arising from Circular 69/63 were not always the sole cause of hesitancy, other reasons were: local government re-organization, doubts about fuel supplies and delay in getting confirmation of Smoke Control Orders already submitted.

New Grant Arrangements

I would now like to go into more detail about the level of expenditure allowed for grant on various types of appliances. Originally most local authorities adhered strictly to the principles contained in the memorandum on Smoke Control Areas and restricted the expenditure eligible for grant to the reasonable cost of providing and fixing an improved open grate with gas ignition. Generally speaking the allowance for a grate was in the £4-£6 range. If more work was done or a more expensive form of adaptation carried out the excess expenditure did not as a rule rank for grant, although in quite a few cases expenditure up to £33 on stoves was allowed for grant purposes, probably to replace combination grates. Subsequently the Ministry explained that up to £12 could be allowed on gas or electric fires, this being regarded as "broadly comparable" to the cost of an improved open grate (£4-£6)!

Compared with the sums now involved these figures look paltry. Appliances costing £25 to £33 are now eligible for grant not only in the special circumstances just mentioned but under circumstances where only £4-£6 would previously have been allowed. Fixing and ancillary costs have also risen steeply due, very often, to the need to replace the tiled surround in order to accommodate an inset stove.

In the main grants now being paid in the region fall within the limits regarded as acceptable by the Ministry, the chief exceptions being under-floor draught grates (six authorities are allowing between £25 and £28) and gas fires (ten authorities are allowing between £18 and £25). The Ministry's figures are:

Freestanding openable stoves (without boiler)	£20-£25
Freestanding openable stoves (with boiler)	£28-£33
Inset openable stoves (without boiler)	£25-£30
Inset openable stoves (with boiler)	£30-£36
Underfloor draught fire . .	£12-£16
Electric thermal storage heaters	£19-£22
Gas fires	up to £16
Oil heaters	up to £16

I understand that the figure for gas fires is under review.

The new arrangements have added considerably to the administrative complications of smoke control and there is now an urgent need for the Ministry to issue practice notes to replace the piecemeal advice being given to individual local authorities all over the country.

Grants in cases of hardships

There appears to have been little change in the procedure for dealing with these cases. Some authorities consider each case on its merits, some consider that all old aged pensioners are deserving cases, although in the majority of cases the need for National Assistance is regarded as the most important factor.

In a few instances the situation is being reviewed in face of increased costs.

Grants to Churches, Chapels, etc.

Here again there has been little or no change in procedure. A substantial number of authorities have not received any applications for grant but most of those who have give 100 per cent, others giving graduated amounts down to 30 per cent.

Public Reaction

Smoke control has been overwhelmingly accepted by the general public in the Region. To my question on this point 63 replies gave an unqualified "yes" and only one an unqualified "no". Whilst public reaction to the changed conditions was not known in some cases or had not become generally apparent it is significant that not one instance of an adverse reaction was reported.

Local Authority Reaction

Whatever has happened in other parts of the country it is clear that there has been no panic in the South East. As mentioned earlier in this report two authorities have, for various reasons, suspended smoke control and nine have slowed down their programmes. A further 19 are seriously concerned about the extra cost but are continuing with their programmes; against this however I am informed that 25 authorities have accepted the additional cost without serious concern.

One aspect of local authority reaction was a source of great disappointment to me. It appears that in a considerable number of cases the officer responsible for smoke control has not considered it worthwhile or relevant to point out to his Council the possible beneficial effect of the changes on sulphur dioxide pollution. How on earth Chief Public Health Inspectors and Medical Officers of Health can expect to carry their Committees with them on issues of this kind if they don't prepare the ground and sow the seed I can't understand.

Availability of Smokeless Fuels and Delivery difficulties

I am dealing with these entirely different phenomena under the same heading because there is so much confusion of thought about them, one being constantly mistaken for the other.

If the householder has an empty bunker and can get no promise of early delivery from his merchant, the position as far as he is concerned, is that the fuel is not available. At the same time however (and this is a situation which has happened frequently within my own experience) there may be mountains of smokeless fuel at the local gas works, a mile or two away. This clearly is a delivery difficulty.

Last winter genuine non-availability of anthracite and dry Welsh steam coal was reported from 16 districts and of premium fuels from 34. Minor delivery difficulties were experienced with hard coke, gas coke and gloco, but the general concensus of opinion throughout the region is that there was very little difficulty during the winter of 1963/64.

In a small number of districts emergency stocks of fuel are kept by welfare organizations for distribution to old age pensioners or other needy cases, and this practice seems to be growing.

The view of the merchants, and one with which I entirely agree, is that it is completely uneconomic to maintain a fleet of vehicles and reservoir of manpower throughout the 7 or 8 months of quiet trading conditions in order to cope with the demand during the rest of the year. The complete absence of casual labour in the South East would make it impossible to operate stand-by vehicles even if they were available. It cannot be emphasized too strongly that in the South East these difficulties apply to coal deliveries just as much as to smokeless fuels.

What then can be done?

The merchants regard the staggering of demand as the most helpful line of approach so that consumers lay down a stock large enough to tide them over a very wintry spell. They also point out the provision in the Approved Coal Merchants Scheme whereby merchants undertake to give priority to bona fide orders notified as urgent on account of illness, old age or infirmity. The difficulties of extending or even maintaining at its present limited level the trolley system (regular weekly or fortnightly deliveries) are regarded by the trade as insuperable.

Other steps which would alleviate the mid-winter delivery problem are:

(*a*) The use of piped fuels in flats where adequate storage for solid fuels cannot be provided, unless a solid fuel vending machine is installed.

(*b*) An extension of the practice of selling fuel in 28 lbs paper bags from garages, ironmongers, etc.

Much ill-informed criticism has been levelled against dealers on account of the price charged for fuel in paper bags. There have been isolated cases of overcharging but in the main the price charged only makes reasonable allowance for the cost of the bag, the cost of packing and the introduction of a middle man. That this trade is serving a useful purpose is evident from the number of people who use it regularly, not merely in times of dire necessity.

(*c*) A willingness, on the part of the householders, to take another variety of solid smokeless fuel if the particular kind ordered was out of stock, would be of great assistance to merchants.

(*d*) The use by old age pensioners and other people of limited means who cannot afford to pay cash for a bulk delivery, of the weekly payments facilities offered by many merchants in the South East.

Turning now from delivery to availability (at the point of production) the outlook is much more hopeful. In my discussions with producers I have formed the impression that the White Paper took a rather pessimistic view of the situation and that in most instances the estimated production figures for 1965 onwards will in fact be exceeded, often by good margins.

I am informed by the National Coal Board that there has been a marked improvement in output of anthracite, and availability for domestic consumption is likely to be somewhat higher than envisaged in the White Paper. The production of MHT briquettes (anthracite ovoids) is expected to reach 110,000 tons a year within the next 12 months and when fully expanded by 1970 330,000 tons a year, 130,000 tons more than envisaged in the White Paper. The main outlets for this fuel are expected to be in London and the South.

The production of Homefire is expected to reach the 1970 target figure by the end of 1966, whilst another new fuel, Roomheat, suitable for use in room heaters or open fires is expected to be available in London and the South before the end of next winter to the tune of 120,000 tons a year. Additional plants are planned having special regard to areas where there are likely to be shortages of suitable solid smokeless fuel for clean air purposes. The Board's plans for these plants could, within the next two years make a substantial additional contribution, perhaps as much as

650,000 tons a year, to the available supplies of solid smokeless fuel.

The recent price adjustment (upwards of course) of Sunbrite should provide sufficient stimulus to the idle coking capacity in the iron and steel industry to increase production to meet any likely demand.

The manufacturers of Rexco and Coalite are both actively engaged on programmes of expansion.

The Gas Boards supplying the Region are confident that if householders in smoke control areas are free to choose the type of heating they want, all demands for solid smokeless fuel can be met.

There are good grounds for believing that the total production of all types of solid smokeless fuel in 1966/67 will be considerably in excess of the White Paper's estimate for 1970, and if this fact is considered in conjunction with the trends shown in the following paragraphs one is left with a feeling that the prospects are better than for a long time and that any Council which is dragging its feet on smoke control will have to find a better excuse than shortage of fuel.

The growing potential of the gas, electricity and oil industries suggests that they should have little difficulty in meeting any demands made on them although, in the case of electricity, it is desirable that space heating should be done by storage, and not by direct-acting appliances.

The new situation makes it necessary to prepare realistic estimates of demand for solid smokeless fuels in new smoke control areas. The hit and miss methods some of us have used in the past are no longer good enough.

Trends in fuel usage

It is appropriate to pass immediately to this subject as any substantial trend towards gas, electricity or oil could transform the solid fuel situation and any trend towards closed solid fuel appliances would greatly ease the pressure on premium smokeless fuels.

There was overwhelming evidence that this trend towards gas and electricity was already taking place before Circular 69/63 was issued and has been accelerated by it. Whilst only four Local Authorities report that this trend is not noticeable in their areas, 69 report that it is, and the following examples are typical:

Edmonton—In the latest area, in spite of many back boilers, 33 per cent of applications were for gas fires and 7 per cent for electricity.

Romford—2,000 gas fires sold in the district in 12 months.

Southgate—50 per cent of applicants selecting gas or electricity appliances.

Lewisham—Considerably more than half of applications are for gas; in new areas with increased grant, a figure of 80 per cent is anticipated.

Woolwich—40 per cent of applicants want gas in all rooms whilst a further 16 per cent want to use gas in at least one room.

Crayford—60 per cent of applicants selecting gas room heaters.

Gas is obviously taking the lion's share of the new demand for piped fuels. Nationally, the sale of gas room heaters has increased from 220,000 in 1960 to 750,000 in 1963 and present indications are that more than 1,000,000 will be sold in 1964.

The latest electric thermal storage heaters are neater and more attractive in appearance than their predecessors and there is evidence that their appeal is increasing. Over 114,000 were sold in the Region in the year 1963/64 and the demand is still rising.

Interest in fixed oil heaters is negligible and underfloor draught grates do not appear to be making any impact worth mentioning.

The increased popularity of solid fuel room heaters (stoves) dates from the introduction, about two years ago, of inset glass-fronted models which project only 6 or 7 in. in front of the fireplace surround. Most people found the older free-standing models much too bulky for small rooms and not particularly pleasing in design either. An appreciable increase in the use of these appliances is reported by 12 local authorities. I have however had difficulty in obtaining actual production or sales figures. The manufacturers, unlike the makers of cars and many other consumer goods, regard their production figures as a trade secret and all I could get out of them was that the figure for 1962 was 100 per cent more than in 1961, and 1963 was 50 per cent more than 1962.

The severe weather in the early part of 1963 persuaded many people that central heating was the only answer to such conditions and there is no doubt that the new grant arrangements have encouraged this trend; confirmation of this comes from nine authorities.

Writing in July it is rather early to assess the effect on space heating policy in council houses but it is interesting to note that even at this stage five Councils have decided to fit openable stoves in their new houses, another will provide warm ducted air for space heating and another, gas heaters or thermal storage heaters.

The replies to this part of the questionnaire provide convincing evidence that in the South East the ordinary open fire is on the brink of extermination and few will be sorry to see it go, least of all those who have any experience of more efficient methods of heating.

The Effect of Local Government Re-organization in London, on Smoke Control

On April 1, 1965, the Councils of 32 new London Boroughs will take over responsibility for environmental health, including smoke control, within the Greater London area. It can safely be said that all will be filled with determination to make this experiment a great success and so far as it is within their power, to give their residents a higher standard of administration and amenities than they have ever previously enjoyed.

Perhaps smoke control will share in the benefits accruing from the pioneering enthusiasm of the new Boroughs.

Even on a lower plane there seems to be good grounds for hoping that the new groupings of local authorities will extend Smoke Control to most of those black areas where nothing has yet been done.

Only one of the four recalcitrant black area authorities in the Division is not involved in local government re-organization; the other three each become associated with groups which appear to be predominantly in favour of smoke control and are already actively engaged in the work.

Administratively and technically re-organization should have a beneficial effect. The establishment of many, if not all, Public Health Departments will include a specialist Public Health Inspector to deal with smoke control. These will be men of wide experience and advanced technical knowledge whose influence on the efficiency of smoke control should be inestimable.

The reduction in the number of local authorities should make co-ordination easier and should iron out those differences in standards and local practice which have been a cause or irritation in the past.

Conclusion

The revised arrangements for grant will be costly but if met with courage and determination will result not only in greater convenience and comfort to householders but also in a considerable reduction in pollution by sulphur dioxide.

Shortages of premium smokeless fuels should be alleviated by the big increases in production now taking place and, if present trends in fuel usage continue, overall supplies of solid smokeless fuels should be assured for the foreseeable future.

SMOKE CONTROL AREAS REPORTS
RAPPORTEUR'S REVIEW

The Divisional Reports were not presented individually but were reviewed and introduced by E. J. Winfield, as follows

Mr. Winfield described the eight reports as varied in style; five being in free-flowing prose and three in the form of analytical, mathematical reviews. Mr. J. Innes had given a report which conveyed some disappointment, possibly disillusionment, but not despair. Mr. A. C. Saword, in his comprehensive review of a wide and varied area struck a strong note of optimism. Mr. G. A. Hiller was similarly optimistic. Mr. G. W. Dhenin had given us a beautifully placid reflection of a division not really troubled by pollution, while Mr. J. S. Hodgins had provided a comprehensive report which laid particular emphasis on fuels and appliances. Of the three analytical reports, Mr. J. Kay had provided some very illuminating tables and his report struck a note of caution, not without hope for the future. Mr. L. Mair reported on an area affected very early by fuel policy and this affected the study and analysis. Mr. W. L. Kay had provided a very meaty review of information secured for the division. Mr. Winfield said he proposed to find matters of similarity running through all reports, individual items of particular interest, and to submit some conclusions.

The first point of similarity was very naturally progress, and it was interesting to extract the comments of the various writers in this particular field. Mr. Innes referred to "little enthusiasm" and Mr. J. Kay to "achievement in the Black Areas of the North West region when taken in the aggregate not being impressive", while Mr. L. Mair had said "at mid-1963 the North East was making reasonably good progress, albeit 26 per cent short of objective! but since Circular 69/63, there had been virtually no effective progress in domestic smoke control". Mr. Saword's comment, ". . . and it will be seen that substantial progress has been made. This progress has not, however, been shared equally between all the authorities; some have achieved more than 35 per cent of their target, while others have made a mere token start or even failed to submit a programme", could be placed alongside Mr. Hiller's paragraph "Local authority opinion overall is in favour of continued smoke control procedure in accordance with approved programmes. Sufficient has been done in the larger centres of population to demonstrate the effect and the value of what was done earlier". Mr. Dhenin has told them that "Only five authorities have established Smoke Control Areas, no great difficulties being reported in the process". Mr. Hodgins announced optimistically that "in the middle of December 1963, Smoke Control in the South East could have been said to be in a comparatively healthy condition."

Secondly they should consider the impact of Circular 69/63 and the White Paper on fuels and here they found the writers in different mood. Mr. Innes referred to "the consequential Circular from the Central Authority causing interest and enthusiasm to decline". Mr. J. Kay said it "had been the subject of debate in local government circles ever since, and had provoked various and divergent opinions." Mr. Mair and Mr. Saword both reported on questionnaires sent out to ascertain effect. Mr. W. Kay tells us "the effect of the issue of these documents was to cause local authorities to re-examine their Smoke Control Area policy". Mr. Hiller described the ". . . . considerable apprehension felt by local authorities in the division, particularly among the officers responsible for the administration of the Clean Air Act."

Mr. Winfield then invited delegates to consider the findings and effects in the eight papers. Mr. J. Kay spoke of slowing down—temporary suspension—discontinuance and refusal to implement because of quality and cost of solid smokeless fuels, increased expenditure in conversions and a sense of frustration. Mr. Mair described the letter of August 1, 1963, preceding Circular 69/63, as a "severe blow to progress in the region". His table showed 17 orders submitted but not confirmed, 3 revoked—7 withdrawn—7 for further review and revealed that after Circular 69/63 there had been "virtually no effective progress in domestic smoke control". Mr. Saword's statement that smoke control suffered a slight setback in Yorkshire as a result of the uncertain fuel situation which developed in the Autumn of 1963, strikes a note of similarity with Mr. W. Kay's survey of 22 local authorities with Smoke Control Areas in operation, 27·2 per cent were continuing as before, 50 per cent had cut back their programmes and 22·8 per cent were halted. The fundamental changes which were envisaged, involving largely the abandonment of the traditional open fire, as well as problems of cost, had aroused concern according to Mr. Hiller, and Mr. Dhenin had mentioned "the national drive against domestic smoke taking something of a knock because a new basic plan had been adopted in place of the original one . . .". Mr. Hodgins reported two local authorities in the region were suspending their smoke control programmes, and a further nine were slowing them down.

Mr. Winfield next dealt with the question of smokeless fuels and the varying opinions throughout the country regarding their availability and cost. A breakdown of divisional opinion showed that in Scotland gas coke was not popular, the price was declared excessive, there was a dearth of premium fuels and transport was expensive. In the North East ample supplies of "Sunbrite" had been assured from official sources and no difficulty experienced in meeting demands for gas and electrical appliances, while in Yorkshire a comprehensive survey of fuel supplies revealed no shortages other than soft coke, but there was disappointment among some sections of the public over the continued shortage of the more highly reactive solid smokeless fuels and on the restrictions on direct space-heating electrical appliances. The West Midlands gives confirmation of supplies, but in the East Midlands the relatively high cost of the solid smokeless fuels when compared with coal, had tempered enthusiasm, a particular grievance being that it had not been found possible to offer a special summer price to those who had room to lay in stores of abundant hard coke. In the South West the rising cost of solid smokeless fuels was causing some concern. From the South East there emerged a picture of general satisfaction.

Mr. Winfield then summarized comment on the financial aspect of changed policy. Undoubtedly the increased cost of conversion was uppermost in the minds of elected representatives. This had prompted the North West to mention that programmes might be slowed up, and the North East, a region which had not for generations enjoyed a fair share of national prosperity and was reluctant to continue with a project, the cost of which had increased some three and a half times overnight. In the East Midlands, smaller authorities had expressed their fears at the increased cost of clean air and in the South East the new arrangements had added considerably to the administrative complications of smoke control. It was felt that there was now an urgent need for the Ministry to issue practice notes to replace the piecemeal advice being given to individual local authorities all over the country.

Mr. Winfield reminded delegates that in the campaign for clean air progress must be largely dependent on the support of the general public, and it was interesting to study the different reports in relation to public opinion. Mr. Innes had spoken of apathy and even some hostility in Scotland and in the North West public opinion was undoubtedly influenced by Press reports of resolutions by local authorities to suspend the creation of Smoke Control Areas, or in some cases, to seek revocation of existing orders. The questionnaire in the North East had shown support for smoke control but in Yorkshire it was difficult to assess opinion. Replies from the West Midlands generally indicated that whilst there was no great enthusiasm amongst the public, the position was accepted, and there is no serious opposition. Public opinion in the East Midlands had been little influenced by the changed situation, while in the South East smoke control had been overwhelmingly accepted by the general public in the region.

Mr. Winfield concluded by drawing attention to what he described as official opinion and national needs, saying that there had been an obvious slowing down in smoke control work since the issue of the Circular. One writer had suggested it was a "severe blow". He would say that the clean air campaign had walked into a very heavy straight left, which left it reeling but not knocked out. He was sure that with proper treatment from its "seconds" it would revive and come forward again as active as ever. The treatment should be a close review of fuel supplies and conversion costs by, not one Minister, but by all concerned with health, fuel and finance. Without doubt, the country needed not merely a national fuel policy, but a strong lead from the Government towards clean air.

Discussion

C. H. **Crawford** (Brierley Hill) said he as speaking for a West Midlands Local uthority which had recently put into rce a Smoke Control Order under hich payments were made in accordance ith the December Circular of the inistry of Housing and Local Govern-ent. 28 per cent of occupiers of premises here adaptations had been completed d changed over to gas or electricity, d a further 11½ per cent had changed to penable stoves or underdraught fires. per cent of occupiers had changed to mbination or room heaters and gas and ectricity. This made a total of 43 per nt changeover from the use of soft gas kes, so that the estimated demand for ch cokes would be reduced accordingly. his movement to piped or wired fuels lly justified the Ministry's Circular. here were in addition houses where one pen fire had been retained, but gas or ectric heating had been installed in other oms. The average cost per house was the region of £30, which was far less an the figure suggested when the ircular was first issued.

In his view, these facts destroyed the guments against continuing with smoke ntrol since it was obvious that the emand for open fire cokes was declining, d the supplies would therefore last nger. The increased cost of adaptations ould be justified by the greater cleanli-ess and reduction in sulphur dioxide missions which would result from the use f gas and electricity.

J. W. Anderson (National Coal Board: cottish Division) said that the report by r. Innes must have been prepared quite me time ago as there was in fact, fficient smokeless fuels for room eaters for as far ahead as anyone could e and the availability of suitable mokeless fuels for the open fire was not y any means even being taken up in cotland. The true supply position was peatedly reported at meetings in cotland and it had been stated to the cottish Clean Air Council, and publicly, at the National Coal Board had romised a plant to be erected in Scotland r the production of Roomheat. There bviously would not be any shortage of itable fuels both for room heaters and pen fires. On the matter of price of omestic smokeless fuels to consumers, r. Anderson said that it was quite wrong that people in Scotland should be led to expect to get smokeless fuel at the same price as bituminous coal. Dr. Parker in his Presidential Address had brought out very clearly the economic advantages of using manufactured fuels as compared with ordinary house coal and, of course, consumers were safeguarded in that these special fuels had to be competitively priced for the market. Attention was also drawn to the declaration by clean air advocates in their propaganda that millions of pounds would be saved: this would more than off-set any higher price for manufactured fuels.

Councillor S. S. Parfitt (Mountain Ash) described a mining valley near Cardiff where he lived and where recently conditions had been atrocious. There had been an evil-smelling fog which penetrated everywhere. Naturally, miners' concessionary coal played some part, but the chief culprit was a vast industrial plant. And what did this plant produce? Smokeless fuel. The local Clean Air Committee had produced a film, which showed the clouds of smoke billowing from the plant. However on one occasion, only faint wisps of smoke could be seen, the occasion being the visit of Lord Robens to the plant. In fairness to the National Coal Board, it should be stated that they had spent £250,000 pounds to try to improve matters. There was one small crumb of comfort. Though production at the plant had greatly increased, the degree of pollution appeared to remain constant.

W. H. Wattleworth (Liverpool) stated that he was very pleased to learn in the new Housing Act, 1964, that grants could now be made retrospective. He reminded the Conference that this suggestion caused considerable apprehension when he raised the matter some four years ago, and therefore having been encouraged by this response in the Act he felt he would like to raise other controversial matters in the hope that the Ministry would provide a solution in future legislation. He thought it was unnecessary for him to present the inadequacies in the rather complicated operation for smoke control areas and, although the grant could be paid retrospectively, there was rather an awkward clause which allowed persons to carry out work immediately upon declaration of the area by the local authority yet they ran the risk of not being paid should the Minister fail to confirm the order.

The necessary steps to declare an order

were so well defined that Mr. Wattleworth wondered what the Minister had in mind in regard to the possible causes that might delay confirmation. The purpose of the retrospective grant was mainly to allow the enthusiastic co-operator to get on with the job but this was now nullifying the purpose by pandering to possible objections. Further, Mr. Wattleworth thought there appeared to be no reason why smoke control should not be on the same lines as Improvement Grants to allow enthusiastic people situated on the periphery of smoke control areas to proceed in advance of the declaration of the areas. Finally, he felt the present tendency to discourage some expensive modernization of dwellinghouses by estimating grant aid on the cheapest form of appliance was deplorable. There was no reason why a suitable criteria could not be devised whereby when a person had spent a large sum of money on central heating that grant aid could not be given up to at least 50 per cent to encourage this type of adaptation knowing that it would still be modern in years to come which did not always apply to the present type of appliances that were still being installed. Appliances installed two years ago were already obsolete.

R. A. Newton (Lambeth) deplored the apparent lack of a sense of urgency in the reports. He reminded the Conference of the deaths in London during the "Smogs" of 1952 and 1962. As to the financial aspects he said: "This is war, and wars must be paid for". He also drew attention to the absence in the reports of any evidence of enforcement of the Section II of the Act in respect of Smoke Control Orders. He hinted at the legal difficulties inherent in rigid enforcement, but was emphatic that the Section had to be enforced.

P. H. G. Grimmett (Wednesfield) commented that where there had been contraventions with regard to the pollution of the atmosphere from domestic sources there had been prosecution undertaken in different parts of the country. Further, if the question of personal prestige was involved, then the pursuance of one's calling should take priority regardless of other considerations. He had recently installed room heaters in 24 bungalows with radiators in bathroom and bedroom. The occupants had talked enthusiastically about them; only one continued to burn coal and soon, he hoped, would be converted by neighbours to solid smokeless fuel. It was not in smoke control area and no grant had bee received. He did not feel that the rank an file of miners were opposed to clean a and reminded Conference that in the day when coal was rationed the Ministry Power had sent a communication to h authority asking them to impress upo people the need to economise in burnin fuel. His authority had replied to th effect that if and when the Ministry Power would see that the miners wer treated in a similar way so that there wa not an abundance in one house and desire for less in another, then they woul be prepared to consider approaching th people of the area generally. If necessar courageous comments had to be made i respect to clean air; the miners had to b advised that they could not stand in th way of its progress, and he did not thin that rank and file were in fact so doing.

An area was established in 1960 withi the Urban District of Wednesfield, wher in many instances further modificatio had been undertaken by the inhabitan themselves, despite the fact that the book were closed and all claims were pai Comment had been made on the fact changes of policy in the implementation smoke control areas. It made no differenc whether an authority was large or smal no officer could ask for a trebling of th cost overnight and this fact had therefor caused a temporary halt in the progress c smoke control. He felt it was a period c reflection on the factors involved. Th impetus had been stopped but in h opinion the impetus would shortly b resumed to ensure the furtherance smoke control orders.

Authors' Replies

L. Mair, Honorary Secretary, Nort East Divisional Council, in his repl expressed the view that atmospher pollution was a national problem, th remedy for which should be regarded a a national burden so far as the financia implications were concerned. Nationa prosperity depended in the main upo the industrial output of the black area whether it be the manufactured article from the midlands, the exported textile from the West Riding of Yorkshire an Lancashire, or the coal production an ship building of Tyneside. The populatio of the clean areas of this country enjoye the benefits of this industrialization an erefore should carry their fair share of aling with the atmospheric pollution ising therefrom. He submitted this gument in support of a suggestion that "black areas" the Exchequer should ar the whole of the cost of the con- rsions in smoke control areas. In the ain the south country share the benefits the industrialization of the north thout the attendant pollution of the mosphere and this could be borne out the statistics to be presented by Dr. raxford in his paper.

A. C. Saword referred to certain formation he had received from the orkshire Electricity Board after his port had gone to the printers. He had ked the Board a question concerning e availability of a mid-day boost for orage heaters, and in reply, the Board d quoted a statement by Sir Ronald dwards—"Storage heating installations e electricity supplied outside hours peak demand and many of them receive boost during the afternoon. I can give u an assurance that the Boards will be ble to provide a daytime boost for all esent thermal storage heating instal- tions and those purchased in the fore- eable future and that, compared with ormal domestic tariffs, the off-peak riffs will continue to be advantageous". Mr. Saword was convinced that for ery moaner and critic of smoke control ere were many who were anxious to go head faster. He was quite sure that if ants were allowed in "black areas" wards the cost of voluntary conversions advance of smoke control orders, we ould have a rush of applicants coming rward with proposals for making their ouses smokeless. That spirit would act a driving force to push any reluctant cal authorities along at a greater rate an they were going at present. It would so have a useful psychological effect, elping people to understand they were eing *given* something which was to their own personal advantage, rather than being *ordered* to do something for the benefit of everyone in general.

W. L. Kay agreed with Mr. Crawford that there was a reduction in the demand for soft gas cokes. Despite the fact that the West Midlands Gas Board had cut back production of "GLOCO"—a most excellent soft coke—by 75,000 tons this year production so far exceeded demand that the Board were seeking export outlets in Scandinavia for an estimated annual surplus of 30,000 tons.

The movement to piped or wired fuels in Brierley Hill was typical of what was happening throughout the West Midlands. It must undoubtedly make a major contribution to clean air.

J. S. Hodgins said that Mr. Newton's remarks seemed a little unfair to the South East Division. His report showed that in the main, local authorities in the south east had not been deterred by the increased cost of smoke control, and with very few exceptions were pressing on with their programmes. Whilst progress had not been as rapid as the enthusiast would have liked, and in fact never was, his report showed that Smoke Control Orders now covered 40 per cent of premises in the Black Areas in the Division; by any standards this was good progress.

Successful proceedings had been taken in the Division for a contravention of Section II of the Act and no doubt if other flagrant cases occurred they would be similarly dealt with. At this stage however, it was worthwhile going to a lot of trouble to secure compliance by persuasion. If a person deliberately flouted a Smoke Control Order it meant that he was not convinced of its necessity; it was their job to try to persuade him to change his mind, before considering legal proceedings.

AIR POLLUTION AND TOWN PLANNING

by

S. R. Craxford, M.A., D.Phil.

*and (Mrs.) M.-L. P. M. Weatherley, M.A.**

THE object of this paper is to examine the distribution and severity of air pollution in towns to see what can be learnt from past mistakes, and how, within the limits of economic possibility, towns may be planned so as to minimize pollution. The basis of any such consideration must be the self-evident but too often neglected principle that the concentration of pollutants in the air is a balance between the amounts emitted into it and the amounts blown away harmlessly by the wind. Both sides of this balance are of literally vital importance. Urban life as we know it cannot be maintained without the emission of massive quantities of pollutants and, without natural ventilation processes, these pollutants would render towns uninhabitable. Since the reduction of emissions of pollutants is expensive, and their suppression economically unacceptable, the utmost use must be made of natural ventilation to make town life tolerable and it is these aspects of the air pollution problem that will be considered rather than details of technical methods of controlling emissions.

Although the discharge of malodorous substances from chemical works may cause intense nuisances in the immediate vicinity, the pollutants that are inescapable in every town and village are those arising from the burning of fuels. The major ones are grit and dust, smoke, and sulphur dioxide. The material forming the grit and dust is largely made up of ash and unburnt coal or coke, to which is added wind-borne dust from roads and sometimes from industrial installations handling solid materials in the open; the particles are all large enough to fall out of the air under their own weight. Smoke consists of carbonaceous material, suspended as an aerosol, and arising from the incomplete combustion of coal or oil; the individual particles and droplets are small enough to remain suspended indefinitely in the atmosphere through which they become diffused and dispersed. Finally, nearly all fuels, coal, coke, oil, contain sulphur, the greater part of which appears as sulphur dioxide when the fuel is burnt, and this gas, like the smoke aerosol, spreads widely through the atmosphere.

In the published national air pollution statistics estimates of the amounts of these substances emitted are given, in millions of tons, for the country as a whole, and while this is entirely satisfactory from the point of view of recording the total emissions, it takes no account of the fact that these emissions are largely concentrated in urban areas. To obtain an idea of the intensity of these emissions in towns, and to set a scale to the problems concerned it is convenient to consider an average town of 100,000 inhabitants —a town of the size of Blackburn, Cambridge, Gateshead, or Northampton, to give a few examples. The weights of pollutants emitted annually in such a town are given in Table 1.

These estimates, which make no allowance for differences in fuel consumption per head of population between the North and the South, are based on statistics for the amount of each kind of fuel burnt in each of the different types of grate or furnace and

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TABLE 1
llutants emitted annually in an average town of 100,000 inhabitants
tons

Source	*Grit and dust*	*Smoke*	*Sulphur dioxide*
omestic heating	—	2,400	1,800
ndustry	1,200	1,300	9,000
otal ..	1,200	3,700	10,800

e experimentally determined values the emissions from each combinaon when unit quantity of fuel is rnt. These values are reasonably ecise for sulphur dioxide but might in error by as much as 50 or 100 per nt for grit and dust, and smoke. In aking the calculations it has been sumed that the population density one person per 1,600 square feet, so at the area of the town is 5·8 square iles. If the town were square, it ould measure 2·4 miles by 2·4 miles.

RIT AND DUST

Since grit and the coarser dusts ttle out of the air under their own eight before they can become subjecd to the large scale processes of spersion in the atmosphere, the oblems posed by them are simple mpared with those set by smoke and lphur dioxide. Grit- and dust-fall as measured at some 1,200 sites roughout Great Britain in 1958-59, ost of them in urban areas, and the ata show that the average for urban eas was about 113 mg/m² day.* his means that the weight of grit and ust falling annually on the average wn (of 100,000 inhabitants) referred in Table 1 is 610 tons, which is half e amount emitted. Having regard to e uncertainty of the emission estiate, it is distinctly encouraging to nd the figures for the emission and for e observed grit- and dust-fall so close together, which is at least consistent with the view that much of the grit and dust falls near its source.

The average rate of grit- and dust-fall in towns varies with their geographical position, as shown in Table 2 where the data are given for the Ministry of Power's Fuel Regions, arranged in order of decreasing deposit.

TABLE 2
Grit- and dust-fall in urban areas
Regional distribution
Average values 1958-59

Region	*Number of sites*	*Grit- and dust-fall, mg/m² day*
Northern ..	90	148
North Midland	79	145
London ..	118	139
Scotland ..	50	121
North-Western	111	119
North-Eastern	119	116
Midland ..	100	110
South-Eastern	50	109
South-Western	20	93
Eastern ..	25	82
Southern ..	11	76

This shows that, in general, the grit- and dust-fall is highest in those regions in which industry is concentrated. These figures are to be compared with rates of grit- and dust-fall for country districts which are of the order of 50 mg/m² day.

The next question is the distribution of grit and dust within towns. Before this could be examined a distinction had to be made between data from gauges sited to catch general deposit in the area concerned and those sited to monitor some particular factory. The results of this investigation are given in Table 3.

These figures illustrate not only how purely industrial areas are, on the average, highly polluted by grit and dust, but also how other types of district may have their grit- and dust-fall considerably increased by the presence in them of particular factories, as can be seen by comparing items 2, 3, 4, 5 and 6 with the corresponding

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* Subsequent years give a similar cture, and since the number of deposit uges has fallen since 1958-59 data for at year have been used rather than more cent data.

TABLE 3

Distribution of grit and dust within towns
Average values 1958-59

Item		*Average grit- and dust-fall, mg/m^2 day*
1	Purely industrial area	219
	Gauge to monitor a particular factory, sited in:	
2	an area of dense old-fashioned housing	184
3	an area of low density housing	124
4	the commercial centre of a town	231
5	open ground in the centre of a town	156
6	the outskirts of a town	123
	Gauge sited to catch general deposit in:	
7	an area of dense old-fashioned housing	158
8	an area of low density housing	92
9	the commercial centre of a town	135
10	open ground in the centre of a town	98
11	the outskirts of a town	80
12	*In open country to monitor a particular source*	84
13	*In open country to catch general deposit*	54

items 7, 8, 9, 10, 11. It is interesting to note, however, that whether particular factories are being monitored or not, the order of increasing pollution is:

(i) outskirts of a town
(ii) low density housing
(iii) open ground in the centre of a town
(iv) commercial centre of a town
(v) dense old-fashioned housing

Although grit and dust are relatively harmless from the point of view of health, as the individual particles are too large to penetrate into the finer passages of the lung, they are so easily seen and recognized as the cause of otherwise unnecessary work in keeping clothes and houses clean, that they, rather than the more dangerous and insidious smoke and sulphur dioxide, give rise to most of the complaints about air pollution. The average urban grit- and dust-fall of 113 mg/m^2 day passes, if not unnoticed, at least as acceptable as a minor drawback of town life, but when the figure much exceeds 200 mg/m^2 day the inhabitants begin to realize that they are living in an unpleasantly dusty locality. Figures of about 300 mg/m^2 day indicate gross pollution.

While the data in Tables 2 and 3 have shown the extent of pollution by grit and dust that is likely to be encountered in the different commo urban circumstances the underlyin theme has been the local nature o such pollution. Experienced observer consider that the major nuisanc usually occurs within one or tw hundred yards of the emitter and i often limited to the premises of th offending plant. Since in any case th particles of grit and dust concerne tend to settle out before they can b removed by large scale atmospheri dispersion processes, abatement o this form of pollution has to rely ver largely on limiting the emission and where this is not sufficient, on correc siting of the emitter in relation t housing. Modern dust-arresting equipment is efficient and can be applie successfully to the vast majority o new plant so that little trouble need be expected from the type of industria plant that is being erected at the present day, and if there is any doub about any particular project, it can be limited to sites on the down-wind side of the town and in particular to sites that are never likely to become closely surrounded by houses. Existing old plant in urban areas are more difficult to deal with, because although the owners are compelled, under the Clean Air Act, to take the best practicable means to limit emissions grit and dust it is often economically possible to reduce them as far as ould otherwise be desirable. Such a ate of affairs may often have to be ken into consideration when re-veloping slum-clearance areas be-use it will in many instances be und that the closely packed obsolete ouses were or still are associated ith just this type of works. It should so be borne in mind that very tense grit and dust nuisances can be eated by handling dusty solid aterials on a large scale out of oors, but inexpensive commonsense ood - housekeeping remedies can ually be found.

One other modern development ould be mentioned, namely the vent of bigger and bigger power ations, cement works and so on. hile they are fitted with the most ficient electrostatic dust precipitators orking at, say, 99·5 per cent efficiency, e throughput is so large that the 5 per cent of very fine dust that sses through represents a large ough weight of dust to cause serious ollution if it is not adequately spersed from high and properly ted chimneys. The problems presen-d by such emissions of dust are erefore more akin to those posed by noke and sulphur dioxide, which ill now be considered.

MOKE AND SULPHUR DIOXIDE

The problems set by the air-borne ollutants are different in kind from e local nuisances caused by grit and ust falling out near their source. ulphur dioxide being a gas and noke an aerosol move with the air so at their distribution depends not nly on the pattern of emitters but on e air currents and winds in and bove the urban area concerned. These ollutants are ultimately blown away to the upper air but the concentra-ons experienced near ground level, here people live and work, depend n the balance between the rate of mission and the rate and details of emoval by diffusion and turbulence rocesses and by the wind.

Since smoke and sulphur dioxide are dispersed by the same atmospheric processes, it is convenient to deal with them together, although bearing in mind their different patterns of emission, as between domestic and industrial sources. The average concentration of each in urban areas throughout the country is about 200 microgrammes per cubic metre, although the yearly averages might vary by at least ±15 per cent according to changes in the meteorological conditions from one year to the next.

An examination of the statistics shows that while the concentrations of those pollutants for the great majority of the days of the year do not differ by more than a factor of two from the average, there are a few days in the winter, when pollution levels are five, 10 or even 20 times greater than the mean. It has been suggested that it would be reasonable to neglect the average days of good dispersion entirely and concentrate on the few bad days on which bronchial cripples collapse and often die. This view cannot be accepted on any grounds. The £250 million pounds worth of material damage done annually by polluted air is certainly not confined to the highly polluted days and on health grounds attention is immediately turned back to the average days by the question as to how normal human beings became bronchial cripples in the first place.

Regional Distribution of Urban Smoke and Sulphur Dioxide

The data for urban smoke for 1958-59 have been analysed in the way shown in Table 4 which shows that there are clearly marked differences according to geographical position. To avoid having the results unduly weighted by towns making observations at many sites, the average concentration for all the sites in a town has been used in each instance. It is not suggested that this is a true average concentration for the town concerned but its use as an index of pollution for the present purpose of comparing groups of towns in different

TABLE 4

Regional Distribution of Urban Smoke
1958-59

	‘Average concentration, μg/m³	*Percentage of towns with ‘average’ smoke concentrations within the ranges*				
		0-100	100-200	200-300	300-400	above 400
		μg/m³				
South of England . .	118	30	70	0	0	0
Outer London . .	140	11	85	4	0	0
Inner London . .	219	0	37	56	7	0
North of England	219	4	36	25	19	6

For this purpose ‘North’ includes as its southern boundary North Wales (Denbighshire), Northern Shropshire, Birmingham, Leicestershire and Lincolnshire.

TABLE 5

Regional Distribution of Urban Sulphur Dioxide
1958-59

	‘Average’ concentration, μg/m³	*Percentage of towns with ‘average’ sulphur dioxide concentration within the ranges*				
		0-100	100-200	200-300	300-400	above 400
		μg/m³				
South of England . .	97	57	43	0	0	0
Outer London . .	163	5	74	21	0	0
North of England	217	8	41	32	14	5
Inner London . .	274	0	5	50	45	0

parts of the country should not be subject to serious error.

There were 20 towns in the South of England, excluding Greater London, making measurements in 1958-59 and their average smoke concentration was only 118 μg/m³. This figure increased to 140 μg/m³ for 26 towns in the outer ring of Greater London, and to 219 μg/m³ for the 27 boroughs making measurements in Inner London, and this was also the average for the 61 towns in the North of England taking part in the survey. It will be noted however that the spread above the average was much greater in the North than in London.

Table 5 gives corresponding data for sulphur dioxide which follows a similar pattern except that Inner London is more polluted than the North of England.

These results lead to the first general conclusion, namely, that in building new towns or housing estates, or in re-building old ones, the greatest care is required, from the air pollution angle, in the North of England and in Inner London. The present position in these areas must be studied to avoid making the mistakes that gave them their unenviable position in the air pollution records.

It is of interest to note the rapidity with which changes in relative pollution in the various regions can occur. Since 1958-59 pollution by smoke in London has decreased at a higher rate than in the rest of the country, partly because of extensive smoke control,

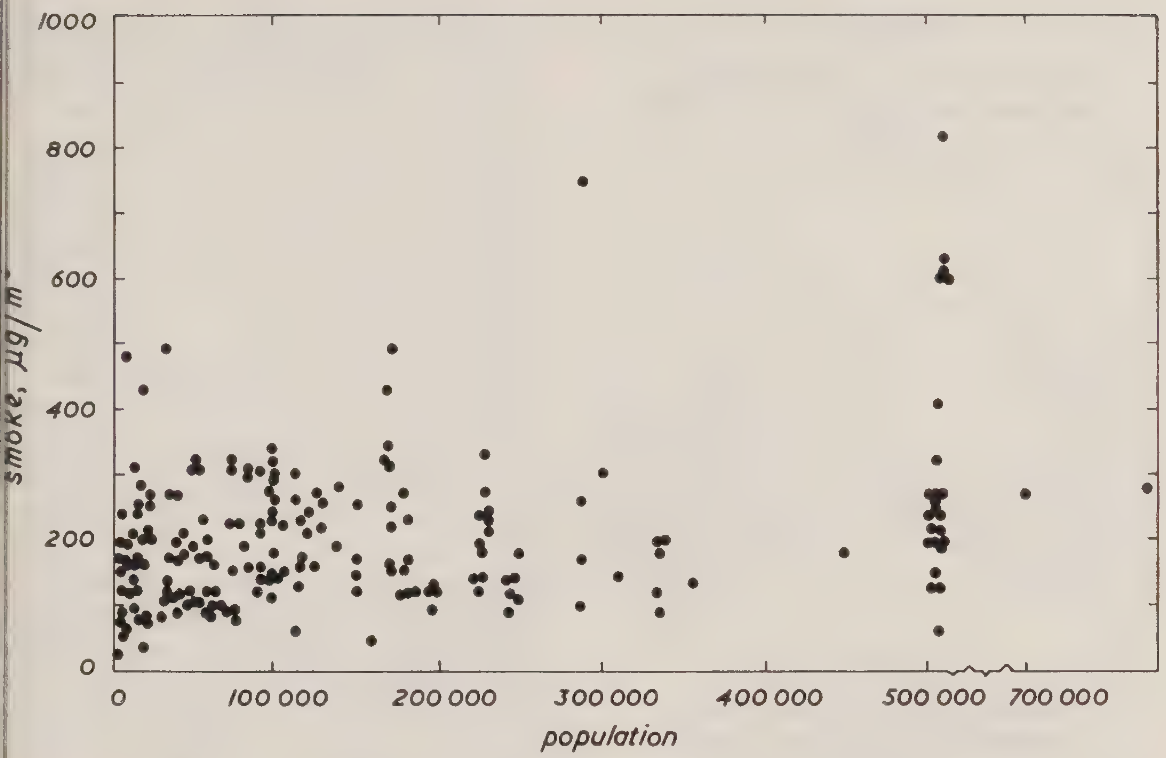

Fig. 1 Smoke in relation to population of towns

artly perhaps because of redevelopient and changes in heating habits.

ize of Town and Air Pollution

It has always been believed that ir pollution is worse in large towns han in small ones but an examination f the available data shows that this is ot so. In Fig. 1 all the yearly average moke concentrations available for 957-58 are plotted against the populaion of the towns concerned and it is een that the size of the town has no ffect on the pollution by smoke. The orresponding diagram for sulphur ioxide follows exactly the same attern. A mathematical analysis of he results shows that while there is a ery weak correlation between smoke oncentration and size of town this is ue not to size of town itself but is a onsequence of the dependence of moke concentration on the populaion density, which in its turn shows a eak correlation with size of town.

The next general conclusion is herefore, that for average conditions, ir pollution problems set no limit to he size of a town. Big towns can be as lean as small ones.

Drift of Smoke and Sulphur Dioxide from Towns

It is highly illuminating to consider the sites throughout the country at which the smoke concentration is less than half the average value for urban areas. Taking this average as 200 μg/m³, the sites at which the observed yearly average was less than 100 μg/m³ in 1958-9 are given in Tables 6 and 7 in order of increasing concentration. The first eight entries in this list (Table 6) are country sites and the remainder (Table 7) are situated in towns. (In comparing smoke concentrations at different sites in this way it was realized that differences in method of measurement could have been largely responsible for the differences in concentration; investigation showed that the basic conclusions were not in fact invalidated when this factor had been taken into account).

The first two sites in Table 6, in the Shetlands and the Outer Hebrides, are as far removed from sources of smoke as they can well be, and it is not surprising that the observed

TABLE 6

Sites with Low Average Smoke Concentrations Outside Urban Areas 1958-59

Site	*Smoke concentration,* $\mu g/m^3$
Lerwick — 1	3
Stornoway — 1	3
Fakenham — 1	20
Settle — 1	21
Cardington — 1	40
Sheffield —60	47
Bingley — 1	57
East Kilbride — 1	58

TABLE 7

Sites with Low Average Smoke Concentrations in Urban Areas 1958-59

Site	*Smoke concentration,* $\mu g/m^3$
Wolverhampton — 3	59
Lancaster — 4	65
Luton — 1	66
Carshalton — 4	70
Woolwich —10	72
Hornchurch — 1	76
Southampton —26	77
Leicester — 6	84
Braintree — 4	86
Kingston-upon-Thames —11	86
Leicester — 7	90
Leicester — 9	91
Kew — 1	96
Lewisham — 6	96
Oxford —12	96

concentrations are negligible. The next two entries are for Fakenham in Norfolk and Settle in Yorkshire, with concentrations of 20 and 21 $\mu g/m^3$ respectively. These sites are in the depth of the country but there are towns within 20 miles and very big industrial towns within 30 miles. The next entry is Cardington, only 3 miles from the centre of Bedford, followed by Sheffield—60, a site high on the moors to the west of the city but only 5 miles from the centre, and Bingley—1 which is only 1½ miles from the centre of an industrial town of 19,000 inhabitants.

These results show that heavy pollution by smoke hardly spreads at ground level from the towns emitting it and the air can remain relatively uncontaminated right up to their lee-ward edges. This is in accord with deductions from calculations on the dispersal of pollutants from towns, namely that pollution falls off rapidly to lee-ward of a town. It does not contradict the spectacular observations from the air of smoke drifting for many miles from a town, or of the reports of smoke from Birmingham being on occasion visible over Oxford because these refer to the movement of smoke high up in the air and not in the lower levels of the atmosphere that we inhabit.

The general conclusion is clear, namely, that drift of pollution from towns is so small that it need not be taken into account.

Distribution of Pollution within Towns

The next entry in the list of sites with low smoke concentration is Wolverhampton—3 (Table 7) which takes the argument a stage further: this site is about 600 yards from the centre of the town, in a residential district with a park nearby. The extremely low average smoke concentration observed here shows that contamination of the air near the centre by smoke emitted in other parts of what is undoubtedly a town of average pollution is comparatively small. Continuing down the list of sites in Table 7 it will be noted that many of them are in large manufacturing towns and even in the London conurbation. All these sites have smoke concentrations less than half the urban average and their very existence emphasizes the thesis that urban conditions do not necessarily preclude a high standard of purity of the air.

The same point is also illustrated by the smoke contour map of London for winter 1961-2, Fig. 2, showing the

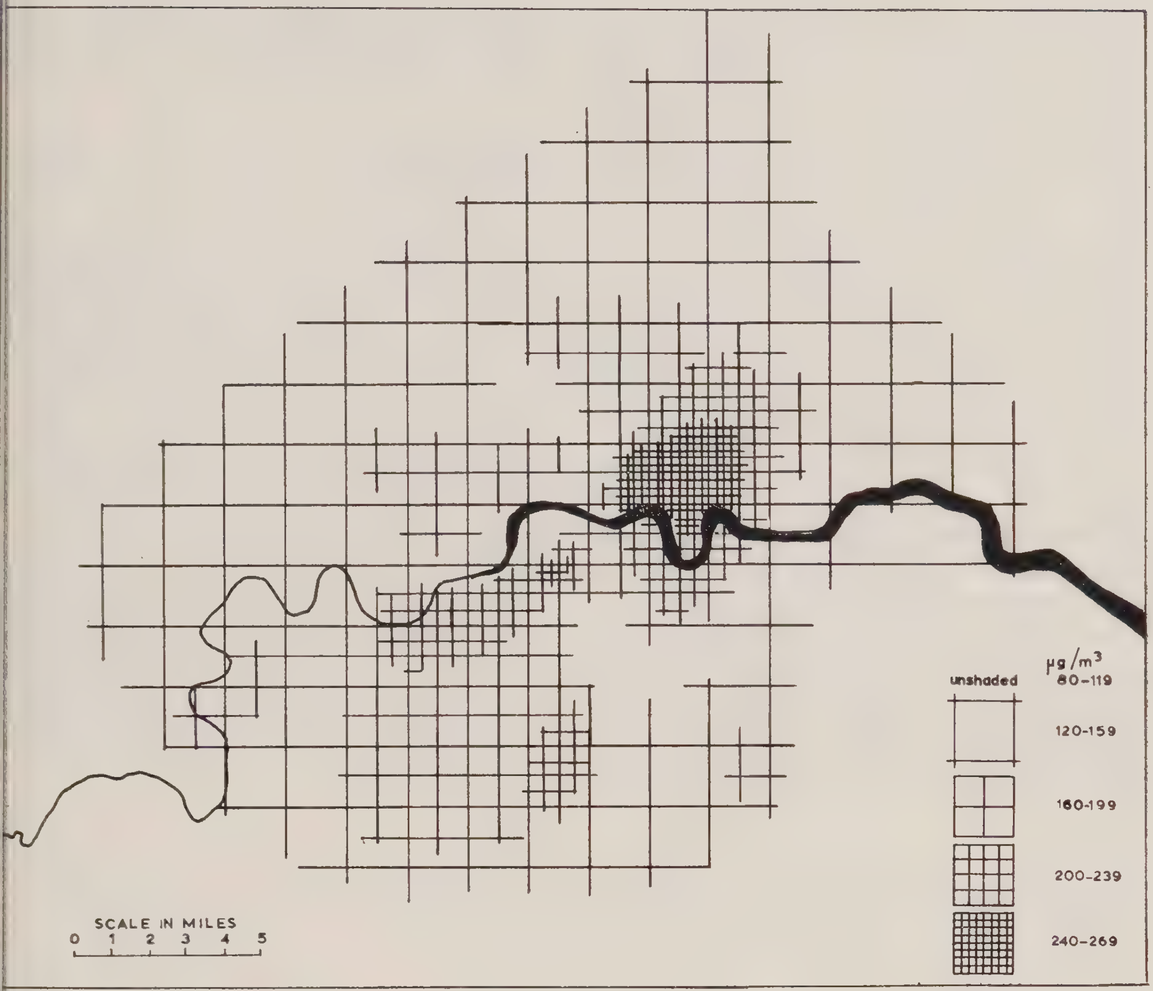

Fig.2 Smoke in Greater London — Average for Winter 1961-62

ntral area including the City, which
a smokeless zone, as having smoke
ncentrations no greater than in
any of the suburbs although it is
rrounded by more heavily polluted
stricts. In case the map gives the
pression that the concentration
ntours are known much more
ecisely than in fact they are, the
sitions of the sites for which
easurements were available, to-
ther with the average concentrations,
e given in Fig. 3. Similar diagrams
r individual days show equally
otty distribution of the smoke, the
apes of contours tending to be
storted in accordance with wind
rection, so that, for instance, the
ntral area remains cleaner than its
rroundings but the shape of the
eaner patch varies from day to day.
ven on a day of abnormally high
llution, such as the 4th-5th Decem-
r 1962, for which very rough pollution contours, much less precise than in Fig. 2, give the picture shown in Fig. 4, the distribution of smoke was still remarkably spotty, as is shown in Fig. 5; in the City area with little or no smoke emission concentrations were considerably lower than at sites in adjoining smoke-emitting areas.

There is however a tendency for clean areas to be affected to a greater degree by smoke drifting in from the surroundings when pollution is high because of inhibition of upward dispersion due to weather conditions. This is only to be expected since there is then more pollution at ground level which can drift sideways. Work by Meetham (London: H.M.S.O. D.S.I.R. Atmospheric Pollution Research Technical Paper No. 1, 1945, p. 72) on contamination of Hyde Park by smoke from surrounding areas showed that the ratio of smoke concentration at the cleanest part of the park to smoke concentration upwind increased considerably with smoke concentration. Examination of his results shows that the absolute difference between smoke upwind of the park and in the cleanest part did not increase with concentration, the average difference being 107 $\mu g/m^3$. A subsequent investigation of smoke inside and outside two small adjoining smoke control areas in Hackney gave similar results, the reduction being on average about 25 $\mu g/m^3$.

The position with regard to clean and dirty areas existing side by side, as revealed by these different sets of observations, is in qualitative accord with the calculations of dispersion from cities mentioned above. It may be summed up by saying that improvements in one area are not nullified, although they will be affected, by smoke drifting in from the surroundings. The policy of smoke-contr areas benefits the areas themselv as well as the city as a whole.

Pollution, Population Density and Fu Consumption

Following up the investigation tha showed no connection between poll tion and size of town, data we obtained for the population densi and domestic fuel consumption in a area of ½ mile radius round each sit The results showed a strong correl tion between smoke concentration an domestic coal consumption per un area, as seen in Fig. 6. This is a indication of the degree to whic immediate surroundings are respon sible for ground level concentratio of smoke at any point, and explai the spotty distribution of smoke i non-homogeneous urban areas as see in Figs. 3 and 5.

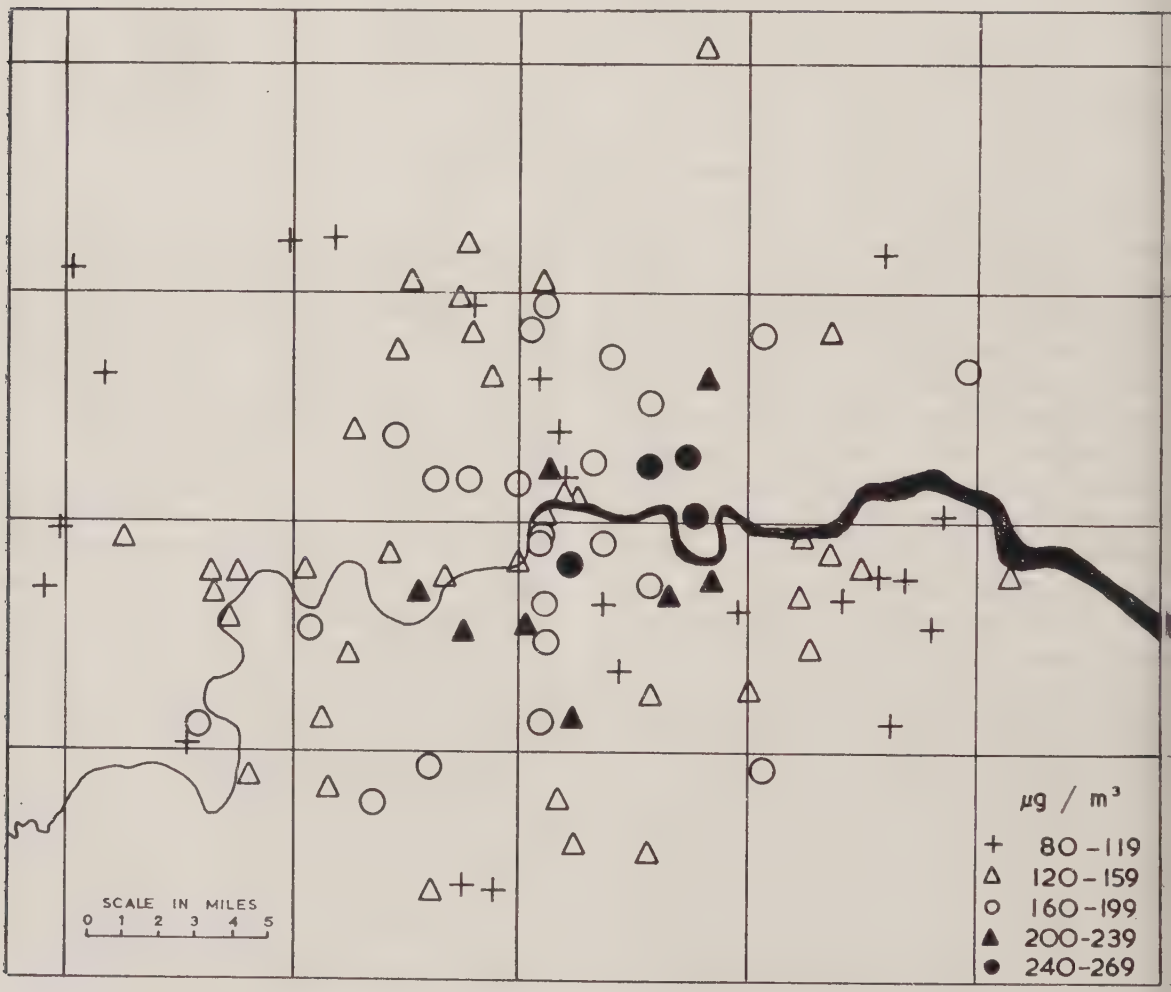

Fig.3 Smoke in Greater London — Winter 1961–62

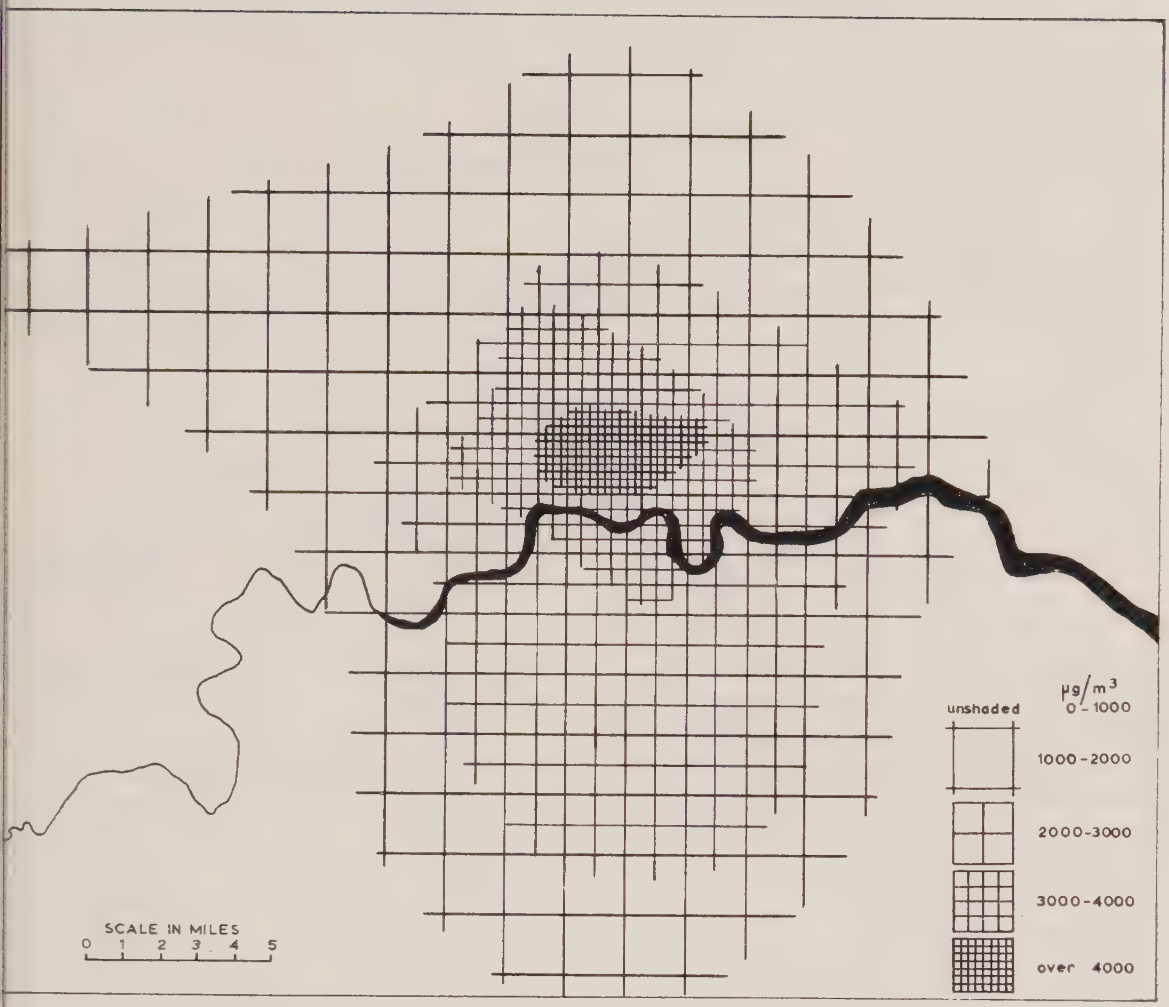

Fig. 4 Smoke in Greater London —— 4th–5th December 1962

HE BALANCE BETWEEN MISSION AND DISPERSION F POLLUTANTS

In the preceding paragraphs some f the results of the balance between ate of emission of smoke and sulphur ioxide and the rate of dispersion in xisting towns have been considered, ut before they are applied to towns f the future, with a view to planning nd design for negligible air pollution, ome other more general remarks hould be made about each side of the alance and the possibilities of modifyg them in a favourable direction. It hould be noted in particular that missions can only be reasonably onsidered in conjunction with the eight of the chimneys from which ey come, low level emissions always ving rise to relatively large concenations of pollutants near the ground hereas emissions from a high level are more easily dispersed without much affecting those who live in their neighbourhood.

Emissions of Smoke and Sulphur Dioxide

Modernization of industry and the Clean Air Act between them have brought about so drastic a reduction in industrial smoke in the last ten years that virtually no problem remains for the future. With a few minor exceptions whatever remaining smoke there is from industry now comes from obsolescent plant, and in any case industrial smoke is discharged from reasonably high chimneys. During that period there has been no reduction in the emission of sulphur dioxide from industrial installations and any industrial expansion in the future will lead to increased emissions. (There has of course already been a big increase if

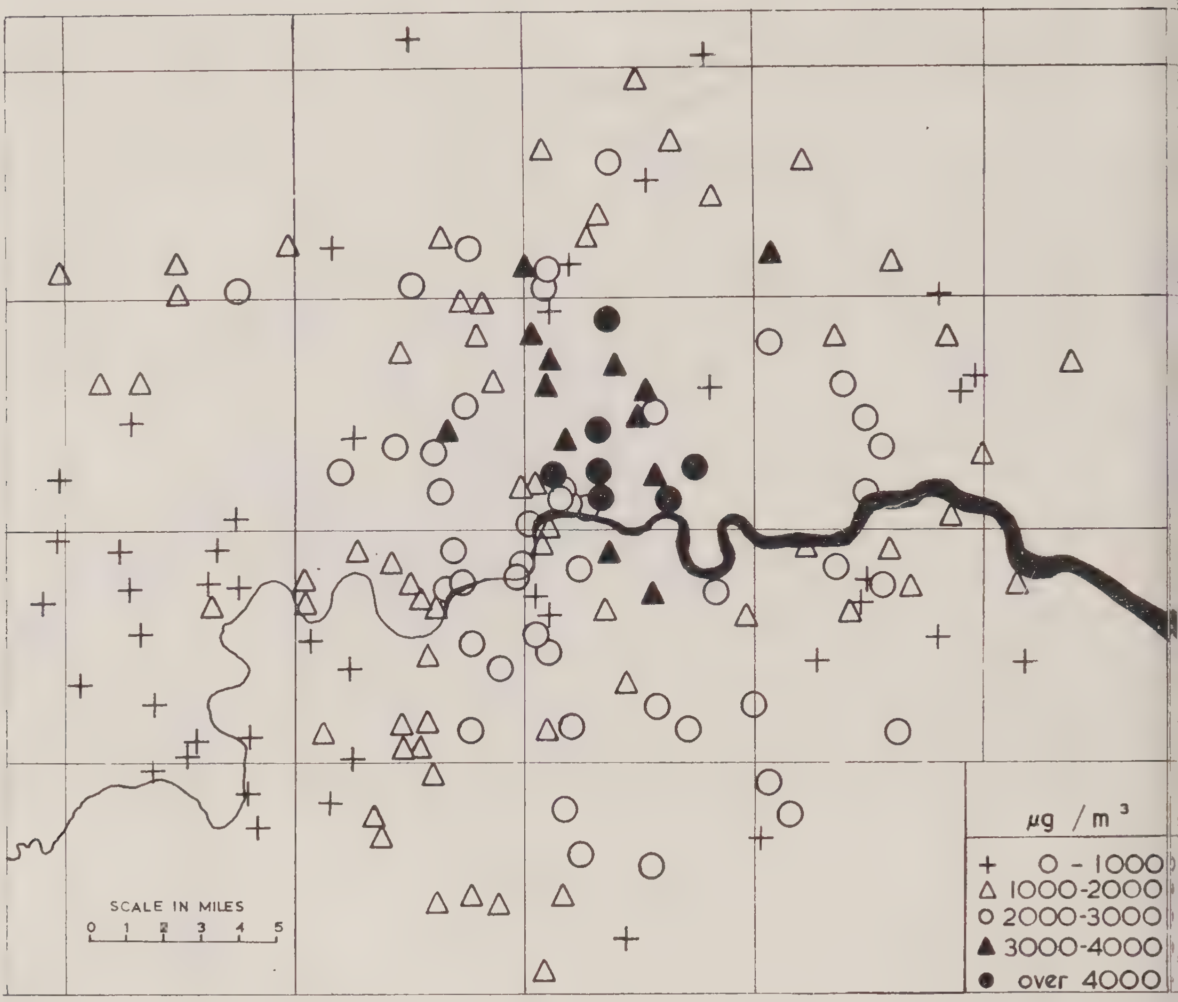

Fig.5 Smoke in Greater London — 4th–5th December 1962

electricity works are counted with industry; there are good reasons for not including them as their conditions of siting and chimney height are very different.) These industrial emissions cannot be prevented as there is no means, and no likelihood of practicable means in the near future, for removing sulphur from coal or fuel oil, or from flue gas, except under the most special circumstances. This statement needs no explanation for coal, or flue gas, but for oil the position is that while a proportion of the sulphur in the crude is removed in the refinery, the major proportion of the sulphur is re-distributed among the fractions so that the production of sulphur-free, or near sulphur-free, lighter and more expensive products is only possible when there is a simultaneous output of high-sulphur fuel oils. Thus, although it would be technically impossible to require all users of petroleum oil to burn sulphur-free fractions, i is entirely feasible for factories i particularly vulnerable positions, from an air pollution point of view, or a times of danger of acute pollution to use lower-sulphur or sulphur-free oil fuels. The decision would b partly one of economics as thes fractions are dearer than the highe sulphur oils. Sulphur-free Kerosene for example, costs about twice a much as the average fuel oil, an oils with intermediate sulphur conten come in between these extremes. It mus again be borne in mind that mos industrial emissions of sulphur dioxid come from reasonably high chimneys In addition, the changing pattern o modern industry is, in many ways favourable to the reduction of ai pollution, and the increasing use o gas and electricity as sources o power are examples that are not t

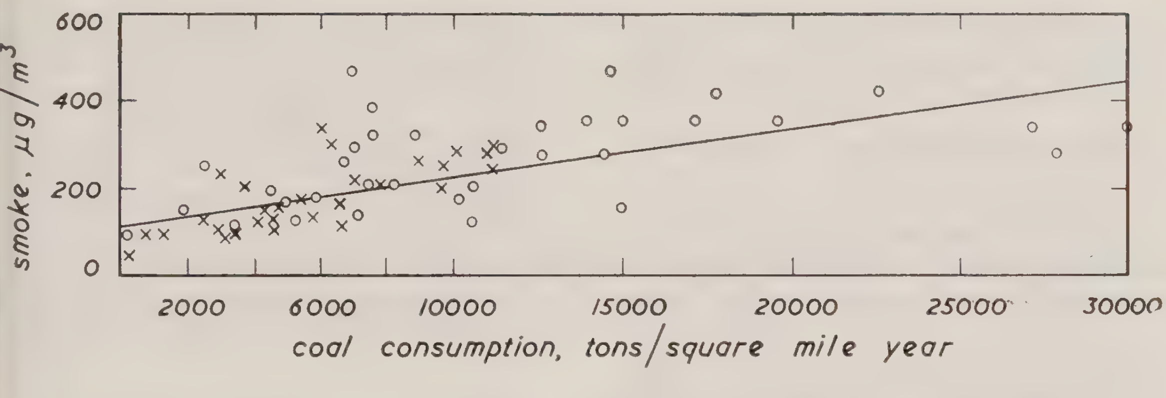

Fig. 6 Smoke and domestic coal consumption

X=London sites O=Yorkshire sites

be lost sight of in planning in vulnerable areas.

Domestic smoke arises from the British custom of domestic heating by individual open fires burning bituminous coal. There is no means, and no prospect of finding means of burning coal in this way without producing smoke. The Clean Air Act seized on the simplest and cheapest means of reducing this emission, namely to replace the bituminous coal by coke which burns relatively smokelessly on an open fire (the others were the increased use of gas, electricity and low sulphur oils). Since supplies of coke were limited the domestic provisions of the Act were based on the setting up of smoke-control areas so that the available coke could be used in the districts most subject to pollution, and in this way most spectacular improvements have been brought about in such places. It was, however, realized from the beginning that this simple replacement of coal by coke could not be applied to the country as a whole and, in fact, over the last 10 years the reduction in domestic smoke emission has only been 10 per cent. The next simplest system is the use on open fires of specially manufactured smokeless fuels, which are dearer and offer only marginal advantages over coke, or the use of hard cokes in closed stoves. Or, leaving individual room heating there is the possibility of bituminous coal being burnt smokelessly in the type of stove that would provide central heating for a whole house. All these methods of heating individual rooms or houses give emissions of sulphur dioxide from low chimneys. In the post-war period there have been two changes in social habit that have affected domestic air pollution and that point the way to the future of smoke and sulphur dioxide abatement. The first arises from women going out to work all day, so that heat is only required in the morning and evening, and the second is that with increasing prosperity but equally increasing cost of domestic labour, there is a demand for labour-saving and convenient methods of heating even if, therm for therm, they are a great deal dearer than the open coal fire, or if they are only dearer because they give greater heat and comfort. It is these changes that have opened up the field to gas and electricity, neither of which produce pollution, and to oil, which is smokeless but may give small to moderate emissions of sulphur dioxide. The more progress that is made along these lines, the better, and there is every sign that such progress will be fast, but the underlying requirements could be met, and probably in many instances much more cheaply, by systems of district heating burning bituminous coal. Such systems would be smokeless and only give emissions of sulphur dioxide from high chimneys.

Dispersion and Chimney Height

While it is extremely well known that increasing the height of a chimney decreases the pollution near the ground, the nature of the effect sometimes tends to be lost sight of. For days on which the dispersion formulae hold good (this is some two thirds of the days of the year, for the rest of the time, apart from inversions, dispersion is very much better) the higher the chimney the further downwind from it will the plume reach ground level and the greater the area protected from gross pollution. The point of maximum pollution is on average some 15 chimney lengths downwind. For greater distances downwind the pollution experienced from the chimney is independent of its height.

Days of Acute Pollution

As explained earlier, there are a few days in the year when a persistent temperature inversion prevents the dispersion of pollutants into the upper air so that their concentration near ground level builds up to such a degree as to cause distress and even death to people whose lungs are diseased. The severity of pollution under these conditions depends very much on the geographical conditions, and if, as well as being trapped from above by the inversion, escape of pollutants sideways is prevented by the walls of a valley, or the rising ground surrounding a basin, conditions can become particularly dangerous as instanced by the deaths in the narrow steeply-walled and highly industrialized valley of the Meuse outside Liége in 1930.

The only absolute remedy for this situation is to forbid emissions of pollutants on the days concerned, which is, of course impracticable, but it is not difficult to devise many ways of limiting emissions at such times at the cost of a little inconvenience rather than hardship. The heights of inversions vary. In some instances no chimneys penetrate through them but in others they do, so that every move towards higher chimneys helps.

Apart from those days of acute pollution, there are times, periods of an hour or so, in many ordinary days when pollution rises on account of temporary inversions, and again the higher chimneys the less effect these inversions will have.

THE INDUSTRIAL CITY WITH CLEAN AIR

In 1950 Dr. Albert Parker gave a lecture to the Royal Society of Arts entitled "Cities without Smoke" which has become a classic of its kind. In this concluding section of the present paper an attempt is made to draw together the scraps of factual information presented in the preceding paragraphs to see how far it might now be possible to go, without breaking all the laws of economic practicability, in designing a city not just without smoke but without sulphur dioxide as well. While few are privileged to design and build a new town, very many are concerned in the re-building of parts of existing towns which is proceeding all over the country. In rebuilding, the long term policy must be to keep as far as possible to the principles laid down for a new town so that the newly rebuilt areas do not become prematurely obsolete when, with increasing prosperity, the whole town ultimately becomes free from pollution. But present knowledge of the distribution and drift of pollution shows that there is a short-term advantage as well, as improvements in one area are not nullified although they will be affected to a greater or less degree by pollutants drifting in from the surroundings.

The Site

Although considerations of air pollution are probably the last to be taken into consideration in choosing the site for a new town, every effort should be made to avoid a site subject to persistent temperature inversions that could lead to episodes of acute pollution. The cost and inconvenience of mitigating, even to a limited extent, the effects of the folly of selecting such a site would not be an inconsiderable item on the balance sheet of the town. The best type of site is an open windy terrain, an excellent instance being the exposed plain on which the new town of Stevenage is built.

When no choice can be exercised, as, for example, in the partial rebuilding of existing towns, extreme care must be taken to limit the emission of pollutants in valleys and basins subject to temperature inversions, by keeping the density of industry or of residential premises to a minimum. What emissions have to be made must be made through chimneys of absolutely maximum practicable height so as to discharge as great a proportion of the pollutants as possible harmlessly above the level of the inversion.

The Industrial Area

From an air pollution point of view there are many reasons why the industrial area of a town should be separated from the commercial and residential districts, and, fortunately, this is an idea that has appealed to the designers of new towns for other reasons. The air pollution reasons are firstly, to avoid fall-out of grit and dust on the residential districts, since this nuisance is known to be a local one, confined to the vicinity of the emitter, secondly, to avoid appreciable pollution of the rest of the town by sulphur dioxide, and lastly, to avoid undue pollution of the industrial area itself by sulphur dioxide by having recourse to chimneys of sufficient height. In a mixed area high chimneys are always frowned upon, and reasonably so, on aesthetic grounds, but in a purely industrial area the problem of an array of tall, or very tall, chimneys is a challenge to the architect and as a successful design could look very impressive.

The most satisfactory arrangement of an industrial area in relation to the rest of the town—again from an air pollution point of view—is to have it in the form of a strip along the downwind side of the town and separated from it by a green area. Again, fortunately, this is an arrangement favoured for other reasons, and Stevenage can be quoted as an example although here the industrial area is on the wrong side of the town with respect to the prevailing wind.

This question may be put on a quantitative basis by referring back to the "average" town described at the beginning of this paper—100 000 inhabitants, 2.4 miles square, industrial emissions of sulphur dioxide 9 000 tons/year, yearly average concentration of sulphur dioxide 200 $\mu g/m^3$. If a town of similar size had to be built nowadays and industry were concentrated in a belt on the downwind side, with a gap of one mile between the line of industrial chimneys and the nearest houses, the commercial and residential town would receive no pollution from industry for about 90 per cent of the days of the year, and for the remaining 10 per cent the highest concentration that could be set up, with the wind blowing directly from the industrial strip to the town would be about 50 $\mu g/m^3$. This result would be achieved without applying any stricter regulations as to chimney height in the industrial area than those in the Ministry of Housing and Local Government's memorandum. Under these least favourable, conditions the average pollution through the residential town by industrial sulphur dioxide would be of the order of 20 $\mu g/m^3$. The annual average pollution from industry would therefore be no more than a few, say less than 5, microgrammes and would be entirely negligible.

The question of chimney height arises to prevent undue pollution in the industrial area itself on the unfavourable days when the wind is blowing along the line of the strip. If the chimneys, at least of the major emitters, were chosen of a height to keep the points of maximum pollution about a mile and a half away, and if these emitters were suitably sited in the industrial strip, the highest sulphur dioxide concentrations in the area itself should not exceed about 100 $\mu g/m^3$ locally and this should only occur for some 10 or 15 per cent of the days of the year. This would require the major chimneys, each dealing with the flue gas from say 10 000 to 15 000 tons of coal, to be some 250 ft. high, assuming a reasonable value of 350 ft. for the thermal rise. This might make the average pollution in the industrial area about 50 $\mu g/m^3$ on the unfavourable days and certainly less than 10 $\mu g/m^3$ on the average for the whole year. With such chimneys the industrial sulphur dioxide in the residential side of the town would probably never exceed 40 $\mu g/m^3$, even on the worst days.

It should be emphasized that these extremely favourable results could be achieved by nothing more than a change from the old-fashioned to a modern system of siting industry with respect to the rest of the town and at negligible extra cost to industry.

The Commercial and Residential town

The conclusion that emerges most clearly from the earlier sections of this paper, and perhaps the most important of them all, is that air pollution of roughly the present severity is bound to remain in urban areas so long as low-level emissions of pollutants from individual dwelling houses are tolerated—emissions of smoke and sulphur dioxide from the burning of coal, and of sulphur dioxide alone from coke or oils that have not been freed from sulphur.

The Clean Air Act was introduced almost as an emergency measure to deal with an acute situation in parts of what are now known as the Black Areas. By basing the domestic provisions of the Act on the replacement of coal by coke, which, unlike coal, can be made to burn smokelessly on an open fire, it was possible to make very considerable reductions in the smoke in the air in the most affected districts by a method which was acceptable to and often welcomed by the inhabitants without being unduly expensive. At the time it was said, and at the time probably justifiably, that more drastic measures would be prohibitively expensive, equivalent, in fact, to pulling down the existing towns and rebuilding them, and that in any case the Briton was so firmly wedded to his open fire that he would never give it up. The position seems very different now, after the lapse of 100 years. Reconstruction and rebuilding of towns is in full swing all over the country and—for good measure—new towns are being built. It would become a matter of great regret in the future if this rebuilding and new building were not done in such a way as virtually to eliminate the evils of air pollution. Moreover, experience in the new towns suggests that the open fire is no longer the universal favourite it was in the past. Increasing sections of the community only require heat night and morning and reject the open fire as inconvenient and impracticable for such usage. Other increasing sections are prepared to devote some of the proceeds of their growing prosperity to greater comfort in their houses and they also reject the open fire in favour of central heating. All these pointers suggest that this might be an eminently opportune time to face squarely the question of the further general reduction of air pollution in towns knowing that where this is done the open fire and other forms of heating of individual houses that produce emissions of pollutants from low chimneys must inevitably be banned.

There must be many systems of heating that could be adopted for a new town without giving rise to air pollution, but the most economic and perhaps the most acceptable, would seem to be a basic system of district heating, with emission of pollutants from high chimneys, together with exemptions for individual houses whose owners preferred other methods, so long as these other methods produced no emissions of pollutants.

One objection to district heating with dispersion at a high level is the ugliness of tall chimneys, even a few, scattered through the commercial and residential area. The solution seems to be provided by the new Shell building on London's South Bank—a tower block some 300 ft. high. The chimney of its large heating plant emerges in the centre of the roof which is sloped up gently towards it, and terminates just above the apex of the blunt cone. It is all but invisible to the casual glance. By adjusting the exit velocity of the flue gas in a suitable way the plume escapes cleanly from the building and disperses as from a normal chimney.

Reverting now to the average town described at the beginning, but which has now had its industrial strip removed a mile to one side, it should be planned with a normal housing density of ordinary two-storey houses and, scattered through the area, complexes of flats each with a 300 ft. tower block in the centre carrying a concealed chimney for district heating plant, fired by coal or oil, to deal with its own set of flats and one-tenth of the houses. The domestic emission of sulphur dioxide for the original town was at an average rate of 1,800 tons/year, or in the winter possibly at nearly double this rate. Taking the whole domestic emission as divided equally between these 10 concealed chimneys it can be calculated that the whole of the domestic heating of the town can be effected without creating a concentration of sulphur dioxide at ground level of more than about 30 or 40 $\mu g/m^3$. The average domestic pollution throughout the town should not exceed 10 or 15 $\mu g/m^3$. Since the blocks of flats can be placed so that one is at least a mile from its nearest neighbour pollution of the upper floors of one will never exceed about 30 $\mu g/m^3$ even when the plume from its neighbour is blowing directly towards it.

Such an arrangement would lend itself to being made extremely attractive aesthetically. It would not be too expensive a form of heating, as can be judged from the reasonable price some of the new towns charge for heating on a rather similar system where one central heating plant serves flats and individual houses.

There would be complete freedom for owners of houses anywhere in the town to opt out of this scheme, if they found it more convenient to do so, and use gas, electricity or sulphur-free oil. The only absolute prohibition would be on coal, coke or sulphur-containing oils.

Having seen the possibilities of designing a town with very low pollution under the worst conditions and with negligible yearly average pollution, there are several rather disconnected points that need making.

The first concerns motor traffic. Here pollution is produced at ground level and has to escape out of the street. The old-fashioned canyon-like city street provided the worst possible situation and modern re-development, almost always favouring wide roads with buildings of irregular height, very far removed from the canyon system, should go a long way towards relieving the problems of pollution from road transport.

The next concerns a special problem of the intermediate stages of re-development, which can bring about the juxtaposition of high blocks of flats or offices and commercial premises of varying height and each with its own heating plant. The fumes from the lower buildings can then go straight in to the windows of the higher ones and can cause intense pollution. Development of very closely spaced high blocks of flats and offices, each with its own heating plant, could also involve the same danger and the minimum spacing of such blocks would be dictated by the concentration of pollutants from one that could blow into the windows of the next.

And finally, for situations where there is any chance of persistent temperature inversions which, for even a few days every winter, may interfere with natural dispersion, provision must be made for so-called 'meteorological control'. This is a system in use in America which places an absolute ban on certain emissions when persistent inversions are forecast. Applied to this country it would mean that on those few occasions works and heating plant in the least favourable geographical situations would have to change over to very low sulphur fuels. In the past the argument has always been advanced against this that there is no storage space available for a few days supplies of such fuels. Such space should always be provided in new developments.

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AIR POLLUTION AND TOWN PLANNING

by

J. K. Page, B.A.[*]

A MODERN city can be considered as a three dimensional array of pollution sources, some fixed and some mobile, located in a geographical agglomeration of similar pollution-producing systems which interact one with another to a greater or lesser degree, according to geographical proximity and the influence of weather.

Pollution control by planning techniques must be considered partly as a regional problem and partly as a local problem. Divisions in air pollution cannot be defined logically on existing administrative boundaries. A particular authority acting alone can only achieve less dirty local air rather than regionally clean air. This is analagous to the concept of a watershed. Fundamentally we must need some organization analagous to a river board to control atmospheric pollution effectively. Just as water supply and drainage problems cannot be handled properly except by thinking in terms of the watershed, so we cannot hope to solve our pollution problems, except by adopting the concept of an air pollution catchment area. No wonder we often become despondent and believe nothing can be done about pollution when our neighbours pursue different goals which conflict. Co-operation in pollution control between adjacent authorities must be given the highest priority.

Air pollution control is only one aspect of planning, and air pollution experts must not overrate the importance likely to be given to it in practice. There is, for example, the very real conflict between the practical and aesthetic requirements of chimneys which is tending to become worse as the scale of the primary pollution generators becomes larger, *e.g.* electric power stations. In practice one must seek the balanced solution that considers all planning aspects of the problem, but this balanced solution must be founded on sound scientific knowledge.

The basic planning aims in pollution control are essentially ecological and should be concerned with minimizing the effects of pollution on the habitats of man and of the other biological systems which man has developed for his leisure and/or sustenance. It is no use providing parks for amenity if nothing will grow in them to give visual pleasure. Unfortunately it is not possible to lay down universal standards as the ecological systems with which we are dealing, vary. The starting point, however, is to decide on the basic ecological aims in a particular area. It is then possible to consider the right way to achieve these aims. It is necessary to separate the problem of reducing existing sources of pollution from the problem of where to locate and how to control new sources of pollution.

One must consider the practical planning techniques available to meet these objectives. Essentially one is concerned with the optimal location or relocation and operation of a three dimensional array of pollution discharge terminals. In a modern English city with a population of n people, there are likely to be roughly about $\frac{n}{2}$ fixed discharge terminals, and very soon $\frac{n}{2}$ mobile discharge terminals, *e.g.* vehicles. (Fortunately, probably, only about one-third of these mobile sources will be able to move at any one time during the rush hour.) It is clear therefore that we are dealing with a multiple source problem, and we should not allow the mathematical fascination of the point source diffusion problem to divert our attention from the main fact that the degree of pollution in a city is largely dependent on the mean source density. This is obviously related to overall building density for a given type of fuel and heating appliance. Excessive preoccupation with chimney height for individual heating appliances based on the calculation of ground concentration of SO_2 from point sources is in my opinion a misdirected pastime in many urban studies for a number of reasons which will appear in the following discussion.

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The first weapon in pollution control in urban areas is clearly control of the mass of pollutants emitted per unit ground area. Progress in pollution control so far has enabled the weight of smoke produced per unit area to be significantly reduced by the use of smokeless fuels in those urban areas prepared to act effectively against smoke. The picture so far as sulphur is concerned is not so favourable, and sulphur dioxide concentrations, if anything, are tending to rise. There are a number of reasons why we should not be unduly optimistic at the present moment. Firstly the density of population in cities is increasing rapidly as we build higher. Secondly the desired standards of heating are rising. For those reasons the basic energy demand per unit ground area is tending to increase, *i.e.* a greater amount of fuel will be consumed per unit area. Furthermore, in centralized plants, oil of relatively high sulphur content has frequent replaced other fuels of lower sulph content. On top of this, it is axiomat with higher densities that the lo level of aerodynamic flow characteri tics will be altered, usually in a adverse direction so reducing diffusio rates at low levels. Fortunately the trends have so far been offset by th reduced fuel requirements of moder well-insulated buildings, the improve efficiency of modern appliances an greater use of electricity, but this do not mean that this will always be s Things may well be about to sta getting worse again, unless we tak stronger measures. One should remember that Britain is a world minority c nearly one as far as long term optimis about pollution control is concerne

The other basic operational technique available to planners is t control the time of emission, *i.e* restricting emission in critical period of pollution build-up. Rationa meteorological techniques have bee developed, particularly in the atomi energy industry, to enable the time o emission to be effectively controlle Such techniques depend on the co-operation of the operators which i difficult to obtain except in a time o emergency. Time control of emissio is therefore not a very effectiv planning weapon against pollutio except in extreme emergencies or fo special industries.

Dispersion

Once the pollution has been emitte the basic problem is then how to disperse it effectively. It is here tha proper planning measures are so important. Let me stress for a start the three dimensional nature of the problem. Two questions must be answered in order to locate a chimney:

(i) What is the correct location in the vertical plane?

(ii) What is the correct location in the horizontal plane?

Neither of these questions can be correctly answered without an understanding of the diffusion process in towns. Clearly wind strength and direction, and height of the inversion level (if any) are critical meteorological parameters but it is no use proceeding in the assumption the wind system of a town bears any close resemblance to the wind system measured on a nearby exposed standard meteorological site. The effective roughness height of a city may be measured in terms of the height of its buildings, which is normally three to four magnitutudes greater than the roughness height of grass.

In practice we may divide the urban air flow system into three layers:

(i) A boundary layer close to the ground, the main characteristics of which will depend on the aerodynamic shape of the adjacent buildings. These normally behave aerodynamically as bluff bodies. In this region the mean direction of flow is frequently totally different from the direction of the free wind stream and may even be in the reverse direction. Furthermore the flow is very variable from moment to moment.

(ii) A relatively turbulent layer close to roof level flowing broadly in the direction of the free wind but extending to a considerable height above the buildings producing the disturbance. This layer deepens as the air flows over the city.

(iii) The zone of free streamline flow, the base of which is relatively close to the roof tops in the windward edge of a city on level ground, but which rises as the wind moves over the city and turbulent layer deepens.

Trees can also disturb the flow system. These may also be topographical complications. In making a decision about vertical location we are deciding in fact into which of these three layers the effluent will be discharged. If it is discharged in the lowest layer a large proportion will reach ground level as the diffusion process in this region will be very inefficient. Furthermore, due to the reverse flow that occurs in the rear of buildings, a lot of the pollution may flow back towards the source building. It is for this kind of reason, among others, that chimneys of domestic houses should rise well above ridge level. However this precaution may prove ineffective in an area of mixed density where the tall buildings interact aerodynamically with the low buildings, producing external downdraughts and even reverse flow down the chimney. A local authority, by erecting a tall slab built in the wrong position, can render flues that have functioned perfectly well for the previous hundred years totally ineffective, but as few people concerned with pollution control ever seem to consult any of the extensive literature which deals about wind flow round buildings, it is hardly surprising that the planning solutions sought prove so poor so often, in practice.

Clearly it is essential to consider the town as a three dimensional aerodynamic system if one is going to find rational planning solutions. Unfortunately it is an aerodynamic system which is changing all the time due to new development. One of the aerodynamic changes which may take place due to new development is that existing chimney terminals previously discharging into Region 2 of the air flow system may instead discharge into Region 1 due to obstruction. The effective height of the chimney is thus a relative and not an absolute concept and cannot be found from any Ministry Handbook, except in the case of an isolated building, or a set of buildings of uniform height.

Terminals located in the middle flow regime perform reasonably well though the high level of turbulence implies a considerable mass transfer in the vertical direction and therefore the classical point source approved cannot be used for prediction ground level concentrations.

Terminals located in the upper region are mainly special tall chimneys and quite adequate theories exist for handling such problems in practice.

Their number is usually relatively small in a modern city, except in industrial zones.

Vertical Location Factors

The following planning considerations would seem particularly important in the vertical location of chimney terminals.

1. Height relative to the source building is not so important as height relative to tall buildings of appreciable bulk.
2. It follows that a lot of complications will arise if high development is allowed to occur in close proximity to any existing low developments which discharge pollution at low levels.
3. If tall and low buildings must be intermixed, tall buildings of favourable aspect ratio should be used, *e.g.* square blocks instead of rectangular slab blocks.
4. Where possible, it is more sensible to integrate flues into tall buildings than to have terminals discharging at mid-levels from lower buildings.
5. The effects of downwash in tall buildings can be minimized by the use of high discharge velocities and high efflux temperatures.
6. Tall free standing chimneys with heights equal to or greater than that of adjacent tall blocks of flats are likely to be totally unacceptable in residential and commercial areas on aesthetic grounds. Tall chimneys are most acceptable in areas specifically zoned for industrial use, but even here resistance will be met on aesthetic grounds.
7. The discharge of smokeless but polluted effluents is tending to lead to an increasing lack of awareness of the actual performance of chimneys, and this is inclined to lead to a situation where aesthetic considerations have excessive dominance.
8. The 2½ times and other similar rules are not applicable to mixed height development schemes.
9. The larger the amount of natura discharge from an individua terminal the more important becomes to consider it as a poin source. Largeness is in thi context a relative concept, an the source strength must be related to adjacent source strengths If possible, large through-par chimneys should be high enoug to penetrate the inversion laye especially in situations wher inversions form frequently du to topographical factors.

Horizontal Location

Let me turn now to horizonta location. So far I have not said anything about the traditional planning approach of optimal location in relation to prevailing wind direction While I believe this kind of approach is very important for terminals discharging in the upper streamline region, the concept of wind direction has very much less meaning in the lower two layers, especially in the bottom layer, where a great number of terminals unfortunately discharge in practice. A large number of experiments have shown that the location of the area of maximum ground concentrations in towns is usually located very close to the region of greatest pollution generation. Zoning conceived in towns of prevailing wind directions may have little significant effect compared with zoning by pollution type and pollution density except in the case of tall chimneys which must be considered as point sources. The aims of residential zoning should be to locate buildings so that the local mass balance is favourable. What is favourable will depend on topography and climate as well as on type of fuel used and method of combustion. Little attention so far seems to have been given in Britain to the American concept of the air pollution potential of sites. It would be interesting, for example, to know if any consideration has been given by the Ministry of Housing and Local Government to the relative advantages of different sites for new towns from the point of view of pollution when considering their initial location. Landsberg, for example, has shown that the prevailing wind speed at a site provides a good correlation with mean pollution levels in big cities of America.

Meso and microclimatological factors are obviously of great importance, especially under inversion conditions, and an extensive programme of research is under way in the Department of Geography of the University of Sheffield on this topic. The flow of cold air down valleys under still clear conditions can result in pronounced local inversions with consequent local high concentrations of pollutants. If the effects of local climate were better understood a more satisfactory pattern of horizontal location of discharge terminals could be determined. It has even been suggested in hilly regions that flue gases should be fed through a pollution sewer to suitably located hill top discharge points above the normal inversion levels.

Prevailing winds during inversions are obviously important especially where there are a lot of high terminals discharging into the trapped air system, and worst conditions normally occur in Great Britain with light easterly winds, which makes one wonder how well thought out are our present town planning atmospheric pollution techniques based on wind direction. The whole approach at present is excessively determined by macroclimatological considerations and the meso and microclimate is rarely effectively considered.

One may therefore draw the following planning conclusions about the horizontal location of pollution sources.

1. Wind speed is more important than wind direction in controlling pollution levels in towns. It is therefore more important to keep the wind moving through the town than to worry in which direction the wind is moving as the location of the area of maximum ground concentration is only slightly shifted from the area of maximum pollution generators by change of wind directions, even in strong winds.
2. Prevailing wind directions are important when considering the location of tall chimneys with big pollution throughputs. These must be considered as point sources, and not as multiple area sources and justify this separate approach.
3. Ground concentrations primarily depend on the mean level of pollution generation over the immediate area. Zoning should be concerned with keeping the mean levels of pollution in an area consistantly low. The relative location of different zones in terms of wind direction is unimportant in view of paragraph 1, but is important in cases of tall chimneys discussed under 2.
4. Distance between zones provides effective protection against grit emission.
5. The highest ground concentrations normally occur under inversion conditions, hence activities which produce a lot of pollution should be carefully located with due consideration of topographical factors likely to lead to inversions. Valley sites are often particularly unfavourable but are often favoured on other town planning grounds.
6. While topography has an important influence on wind flow, worst conditions are likely to occur with very light winds. Such winds may be generated by thermal forces rather than by normal meteorological means, for example, katabatic winds. The urban wind system under conditions of high pollution may be very special with many very local characteristics. In general, however, one may say the worst conditions in Great Britain normally occur with light easterly winds. It follows that location of tall chimneys by consideration of

prevailing wind directions only may enhance the problem of extreme pollution under bad inversion conditions.

7. There is considerable horizontal interaction between adjacent towns which must be considered when areas of high pollution density abut.

The Mobile Sources of Pollution

I would like to conclude this talk by considering the $\frac{n}{2}$ mobile sources, which have been very much neglected as pollution sources by British planners, though there is plenty of American experience to show why it is dangerous to do this. Though we are likely to be spared the ozone problem due to the lack of sunshine, the amount of pollutants produced can become quite appreciable at high traffic densities. This Society has given considerable attention to the problem of diesel fumes but the petrol engine is very important too.

Once again the two main weapons of control are control of output at source and improved diffusion. Members of the Society are doubtless aware of the steps that have had to be taken in California to reduce output at source, but my main concern today is to discuss the pollution problem from the diffusion point of view. Anyone who has driven through the Mersey tunnel day after day as a commutor, as I did for three years, knows how bad conditions may become under poor conditions of diffusion. Yet very little serious consideration has been given to these problems by the majority of contemporary town planners. In my opinion the Buchanan Report seriously underestimated the problem of dispersal of traffic fumes in high density urban areas, but the more we adopt three dimensional techniques of planning, the more attention we will hav to give to the dispersal of traffic fume and dirt, (some of which, of cours comes from the tyres). It is all ver well separating pedestrians from traff but if the traffic is placed a hol below, some way will have to be foun for getting the muck out, and this wi not be easy. Naturally ventilate vehicular tunnels can be considered a vast chimneys laid on their sid producing special problems close t their mouths. The best location fo vehicles on grounds of pollution i raised well above the general environment where the air flow patterns ar favourable for dispersion. This positioning may conflict with other town planning requirements, e.g. interferenc with visual amenity.

A vast amount of work needs to b done in order to understand th various factors at work, but we canno afford to become complacent abou the pollution problem in replanning our cities along Buchanan lines. At the moment the problem is hardly recognized by the majority of planners. They would, however, be well advised to take a good long cold look across the Atlantic before it is too late. Half the pollution in certain American cities is said to come from vehicles.

Some people are hopeful that pollution problems will no longer be serious in years hence. I think this a wrong interpretation of a situation which is throwing up new problems all the time which supplant the old. Therefore town planners will have to become much more aware of the scientific issues involved if they are going to keep abreast of the new problems rather than flatter themselves they have solved the old problems. For a start there are going to be many more of us living on the same amount of land shortly, and this in itself will bring a spate of new town planning problems involving pollution.

Discussion

Anthony Goss (Head of the Leeds School of Town Planning) in opening the discussion said he was one of many planners, he believed, who would argue that town planning was now long overdue for an overhaul. They had reached the situation in this country, as far as planning was concerned, where only a tenth of the outstanding problems had been solved. Too few people were involved in planning and those were mainly chasing round on development control activities. The amount of creative planning being done was precious little and he hoped that as they now had a Minister of Land and Natural Resources the gap which existed between the efforts to reduce air pollution and the efforts to plan towns might come together, if we assumed the obvious fact that air was a 'natural resource'.

He felt the conference had been well served in the papers presented by Dr. Craxford and Mrs. Weatherley and by Professor Page and that the real bones of what they were trying to discuss was how to plan towns to minimize pollution. There were really two aspects to this which needed to be separated. Dr. Craxford's paper referred to the planning of new towns as well as certain problems of re-planning existing towns; two rather different sorts of problems as far as the minimization of pollution was concerned. One way to improve planning was to increase knowledge. They had had a position where, in the absence of knowledge people had used "guessology", and were wrong in many cases in the guesses which they made. He thought Professor Page would agree that we were only at the beginning of obtaining more exact knowledge about the whole position. As far as industry was concerned, the paper by Dr. Craxford and Mrs. Weatherley had made the point that new industry was not so great a problem nowadays, but even with the Clean Air Act, there was still the problem of how you deal with old industry which was using inefficient plant and producing a great deal of air pollution. This was really at the root of a great many town planning difficulties: the problem of getting old industry with a smoke nuisance either out of an area altogether into another or effecting its conversion. Basically it was a problem of money—the compensation to be able to remove the nuisance. The London County Council estimated, some time ago, that to bring out from the central, inner areas of London, all the industry they really wanted to move into other areas would cost a considerable amount of money. They had about half a million pounds available each year for compensation for industries moved in this way but it would take something like 250 years to do it at this rate per year. If the community was not prepared to pay the money a very difficult situation was produced. One continually came to the compensation problem in planning and if it were not solved there could be no solution to many planning problems.

As far as the siting of new industry was concerned, it seemed to him that the paper contained a fair number of examples of "guessology". We were told that the best site for a new town was an open windy plain from the point of view of pollution. However, from other points of view an open windy plain might not necessarily be a good site for a new town. There had been serious criticism of the siting of Cumbernauld new town because it was on an "open windy hill" causing a considerable degree of discomfort to people when they were walking about. Hence the obvious question—would it not have been better to have sited it in a relatively less windy valley from the viewpoint of people's comfort? He would like to be much more convinced that they had all the facts straight before they decided on open windy plains for the sites of new towns.

Mr. Goss then referred to the "prevailing wind" theory and the Ministry of Housing Memorandum on "The Use of Land for Industry" issued in 1955. Many towns did not have a prevailing wind which determined their leeward side; on the contrary, winds from two or three directions might be almost equal in frequency. Moreover, the winds which blow with greatest frequency were often either the strongest or those characterized by marked atmospheric instability, thus causing rapid horizontal and vertical dispersal of smoke and dust. In contrast to this, the slow, local flow of air under stable atmospheric conditions might largely determine the area of concentrated pollution. Professor Page had rightly said that much more knowledge was required of the local micro-climate conditions.

As to the question of industry as a strip on one side of the town, planners had come to the general conclusion that it was quite wrong to have industry in one piece because this caused traffic congestion. In the Mark II new towns, like Cumbernauld, two industrial areas exist on two different sides of the town; also in the study for a new town in Hampshire, it was proposed to have three industrial areas, and he thought they would find that nearly all the Mark III new towns were likely to have at least two and probably even three and four industrial areas. For a whole number of reasons, industry needed to be split into several areas. As far as new towns were concerned, it should become possible to distinguish between the relatively cleaner industries from the point of view of pollution and the others. They already had some very clean industry, industry in particular which used electrical power, which was quite suitable for association with residential areas. If one could eliminate a lot of the problems which were traditionally associated with industry, then it would seem that it was quite ludicrous to start thinking in terms of the siting of such industry purely on the basis of the air pollution which it no longer produced.

Mr. Goss concluded with a reconsideration of the district heating question. If the domestic consumer were the main source of smoke pollution, as Dr. Craxford's paper seemed to indicate, then they should be looking a bit further ahead at some of the problems from a much wider point of view. It would be worthwhile doing some sort of cost-benefit analysis, not only in terms of the cost of district heating plant but in terms of the amount of work which was involved in keeping domestic fires stoked, the amount of work which was involved for housewives, the amount of extra cost which was involved in house designs, or in terms of the cost of deliveries of fuel and storage capacity, etc. Many problems of district heating had yet to be solved, such as the question of its flexibility in use within the house and acceptable methods of charging for heating, whereby people did not feel they were paying for their next door neighbours' heating. In this age, when they had industrial methods in building being considered, industrial methods of producing heat had to be considered as well. They had, he thought, grossly over-estimated the desire either for a smokeless or a smoky flame; what people were really after, in a relatively more affluent society, was more heat. If the North of England could set the pace in terms of district heating, then they might be able to do a great deal more to resist the drift southward of population.

P. Draper (Individual Member) said thought the authors had presented helpful and well balanced paper thou one important technical aspect called f amplification. The authors advocat district heating provided from sourc scattered through new towns but right objected to tall, unsightly chimneys an suggested a solution had been provided the South Bank Shell building in Lond in the form of a tower block some 300 high with a central chimney in the ro terminating just above the apex of a blu cone. Further, that by adjusting the ex velocity the flue gas plume escaped clean from the building and dispersed ad quately.

This proposal provided no easy solutio Wind tunnel tests had determined that order to prevent flue gases from bein drawn down the lee side of a building, was necessary to ensure a minimum flu gas exit velocity of 50 ft./sec. at all boil loads, not just at maximum or eve average firing rates. This necessitated th installation of an elaborate system of ga blowers too intricate to be described i the discussion.

If town planners and architects were t implement the authors' recommendatio that new towns should embody complexe of flats each with 300 ft. tower blocks t conceal chimneys for district heatin plants, they should be warned tha impossible conditions of air pollutio would result unless quite high chimney were constructed on top of the towers o else adequate blower plants were installe to boost the gas exit velocity, particularl at low boiler loads.

Mr. Draper concluded by saying tha the same principle would apply to al buildings in which the architect attempte to disperse with projecting chimneys an that it was essential to follow th recommendations of the Governmen Memorandum on Chimney Heights o else to arrive at some adequate alternative

J. P. Detrie (Centre Interprofessionne Technique d'Etudes de la Pollutio Atmosphérique, France) said that new regulations had just been made in Paris against atmospheric pollution from both domestic and industrial sources. He regretted there was no time to mention the principal features, but emphasized that the adopted standards were very stringent, amounting to the prohibition of all visible smoke, smoke being defined by a Bacharach indicator (which had to be below 6 for all fuels) and to a limitation of dust emission which had to be below 0·6 grams per thermie* produced.

Regarding SO_2 fuels containing more than 2 grams per thermie of sulphur were prohibited; moreover, for small and medium powered boilers with an output below 350 or 1,000 thermies according to zones, only the domestic fuel with 0·5 per cent sulphur was authorized.

Commenting on the remarkable study by Dr. Craxford on pollution in cities, M. Detrie stated that the study made in Paris emphasized the importance of housing density per square metre which corresponded in turn to the density of combustion and therefore to the emission of pollutants. He doubted whether the increase of this density by high buildings or by underground car parks could contribute to a lessening of pollution.

R. A. Newton (Lambeth) said that the flue terminals of the Shell building were level with the top of the roof and employed a fan system which ejected flue gases high into the air above the roof.

R. C. Gordon (South Eastern Electricity Board) said he was particularly interested in the paper presented by Dr. Craxford and Mrs. Weatherley that morning because, besides drawing attention in a most impressive way to the seriousness of air pollution it went on to put forward positive proposals for dealing with the problem in new towns. He was somewhat disappointed by the nature of the solutions which were advocated, namely the provision of coal fired district heating schemes with high chimneys for domestic heating, and wider roads and irregular building levels for road transport pollution. Those proposals might well improve the situation but they certainly would not solve it.

In drawing attention to the rising public demand for heating by electricity and gas the authors had said that the more progress made along those lines the better. Would they not consider the provision of district heating schemes by electric floor-warming or thermal storage heaters a more satisfactory solution for heating new towns? For such schemes no capital outlay would be required for the central power unit as this could be generated at a remote power station. Moreover the capital cost of installing the heating systems would be much lower; electricity at low summer rates would be available all the year round and cause no air pollution whatever. Would it not be better, he asked, to divert the main traffic from town centres and advocate electrically propelled vehicles for all local traffic?

D. Thomas (University of Newcastle upon Tyne) said he was proud to be official University delegate from Newcastle upon Tyne—which had pioneered in honours degree standards of education for town and country planning since 1947. He wished to assure the conference that, on average, fifteen students had left that school every year for the last twelve years (it had been a five-Year Course in the early years) and all of them had received lectures concerning the influence of micro-climatic and topographic influences upon the siting of land-uses within the plans of towns and villages. In the nature of things it was unlikely that these men and women would be authorized to attend such conferences as this one, because of their relatively junior positions, and the extreme shortage of planners in public and private offices. However, he was quite certain of the accuracy of the following statements:

(1) At least one graduate had written a thesis entirely upon the influence of micro-climate upon site-selection and building-layout; several had used the topographic and micro-climatic influences as criteria for creating land-use policies for Town Maps (for example, power-stations and off-shore winds, warehouses, car parks and air-conditioned offices which they proposed as the land-uses most suited to the micro-climate of the steep-sided valley where the Tyne passed Newcastle and where on-shore winds sometimes obstructed the sea-ward flow of smoke polluted air).

(2) In lectures on Site-Planning and on Urban Design attention had always been drawn to examples of pollution affecting the "natural selection" of sites for different land-uses (for example, the abandonment of fine houses to office users which occurred after road and bridgeworks had constricted one end of an inclined railway cutting which had previously allowed locomotive smoke to drain away between its high grassy banks; the Planning Appeal which was almost (and should have been) "won" on the grounds of severe pollution of a natural air-pocket where the housing authority proposed to erect bungalows for aged persons). The basic fault in Stevenage

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* *Thermie: the tonne-calorie or megacalorie* $=10^6$ *calories, or nearly* 4,000 *Btu.*

New Town, referred to in the paper by Dr. Craxford and Mrs. Weatherley, was not its only basic fault in the matter of pollution: much of its housing was on a slope rising from the windward industries to a crest where air cooled at night, slipped down, carrying absorbed pollution from upland to valley, enveloping to eaves-level the houses built there by the New Town Corporation. One manufacturer had used a photograph of this phenomenon in advertisements which advocated an anti-corrosion treatment of metal windows and this had made a good slide for lectures on air pollution and site-selection in the Newcastle Course.

He would be pleased to pass on to students whatever he had learned at the conference which was reliable and apposite. Planners were taught to respect facts and to apply them as factors in planning—which was a logical and not an intuitive process—but they could not be rightly censured for wrong decisions when they had not been given reliable facts—he had heard three speakers at the conference differ on a matter of specific fact.

Councillor E. C. Pepperdine (Welton R.D.C.) said the conclusion that there was negligible downwind drift conflicted with his experience and, with respect, his commonsense. It could be demonstrated that fairly dense smoke frequently drifted considerable distances downwind, even at the surface. On isolated occasions smoke from continental sources had reduced surface visibility over Eastern England to less than half a mile even after spending three days out over the North Sea.

Dr. K. Gräfe (City of Hamburg, W. Germany) said his presence as representative of the Land Senate of Hamburg was in some measure a tribute to the work of the Society. He praised the system of Smoke Control Areas and was sure that it would make further progress and stressed that the German regulations did not go as far with air pollution caused by domestic heating. He referred to a paper by Dr. Reidat and himself in which it was shown that they found nearly the same amount of pollution by domestic heating as in this country, when they published the results of dust and SO_2-measurements of Christmas 1963 (s.Gräfe u.Reidat, "Tagesgang von Luftverunreinigungen und meteorologischen Faktoren" in Archiv für Hygiene u. Bakt. 148, p. 299-309 (1964).

Concerning the differences of emissions
caused by the differences of temperatu
between the north and the south of Gr
Britain, mentioned by Dr. Craxford,
Gräfe asked whether the differ
emissions were not mainly caused by
kind of fuel used and not by the variati
of temperature.

W. M. Lewis (Warwickshire Clean
Council) said that local authorities w
faced with a particularly difficult probl
because generally speaking the major
of their buildings—schools, council offic
welfare homes etc., were located
residential areas. Modern architectu
insisted on incorporating large wind
areas invariably of single glazing w
resultant high heat losses. The heati
plant in such establishments was usua
of the low temperature hot water vari
and because of the dual responsibility
caretaker/stoker duties with its dema
on employees time, fuel oil burni
installations had been viewed mo
favourably than solid fuel installations f
such establishments. Lack of appreciati
of fuel oil quality by purchasing officers
corporations generally led to the practi
of purchasing annual supplies of fuel
on a competitive basis—1/16 penny p
gallon frequently influencing the ultima
choice. Injudicious choice of fuel oil oft
led to plant operational difficulties a
more seriously abnormally high pla
maintenance costs in addition to i
creased atmospheric pollution due
sulphur gas emission.

Coventry's experience showed th
corrosion in low temperature hot wat
plant operated by the type of personn
described was proportional to the sulph
content in the fuel oil used, resulting
boiler "back end" corrosion and hig
maintenance costs. Additionally the u
by local authorities of the normal
available 200 seconds viscosity fuel
with 3 per cent sulphur levels increase
low level acidic sulphur gas pollution i
those residential areas. Local authoritie
he said, should discriminate in oil qualit
purchased and thus play a realistic part i
influencing local manufacturers that a
pollution from sulphur gases in town
could be reduced to the benefit of th
community generally with no extra co
involved and often a saving on plant wea
By analytically examining all 200 secon
viscosity fuel oil available in this countr
Coventry Council had been able to choos
a variety—at an economically competitiv
price—with sulphur values less than 1 pe
cent. *i.e.* approximately one sixth th
level found in the normal supplie

purchased. By so doing, in addition to savings effected on the plant maintenance side, the Council were setting a good example to the community generally and in each period of 12 months—on the large quantity of fuel oil they used—were emitting some 230 tons of sulphur gas less in mainly residential areas than was previously emitted when using the normal type of fuel oil with its 3 per cent sulphur content.

Mr. Lewis would be pleased to assist other local authorities who were interested in following the example of Coventry by providing such information as they desire in combating the ever increasing monetary embarrassment of plant maintenance and in their attempt to reduce low level acidic sulphur gas emission to the atmosphere.

Author's Reply

Dr. Craxford, replying to the discussion, said that Mr. Goss' opening contribution drew attention to some of the factors other than air pollution that had to be taken into account in town planning and which might make a plan which was ideal from an air pollution point of view far from ideal in other respects. While this was clearly true, the object of Mrs. Weatherley's and his paper was to emphasize the air pollution aspects in the hope that they might in future be allowed their due weight alongside these other considerations rather than suffer the neglect that had so often been their fate in the past. He agreed entirely with Mr. Goss on the lack of knowledge of the micro-climate of urban areas and had in fact arranged for a reasonable proportion of the effort of the Warren Spring Laboratory's Air Pollution Division to be devoted to these problems. The Laboratory was also actively supporting the investigations of Professor Garnett at Sheffield in the same field. In this connection, he was very gratified to hear the account Mr. Thomas had given of the flourishing School of Town Planning in the University of Newcastle-upon-Tyne.

Mr. Draper and Mr. Newton had referred to the difficulties of getting flue gas away cleanly from the top of a high building. While the Shell Centre tower showed that this could be done, there was always the possibility that with less careful design, entrainment of flue gases in down currents in the wake of buildings might cause severe pollution problems. The Warren Spring Laboratory was now examining this by field studies and by work in a wind-tunnel.

Dr. Craxford congratulated Monsieur Détrie on the regulations limiting the sulphur content of fuels burnt in Paris, but mentioned that in London much the same result had been obtained by agreement in the restricted area of the City, and as Mr. Lewis had told the meeting, a similarly happy result was obtained at Coventry by skilful purchasing. He said that both he and Mrs. Weatherley would like to take this opportunity of acknowledging the help that had been so freely given them in their work by the Paris authorities, by Monsieur Détrie and his organization, and by the Laboratoire d'Hygiéne de la Ville de Paris.

Mr. Gordon had stressed the superiority of electricity, and gas, for domestic heating, from air pollution, not to speak of other points of view. While this is incontrovertible, the view was taken in the paper, possibly wrongly, that these industries might find it embarrassing if they were asked to take over the whole of the domestic heating load for all new premises and provide heating at a cost competitive with that for the other fuels.

In reply to Councillor Pepperdine Dr. Craxford said that the whole question of drift of pollution was fraught with uncertainty. Under certain conditions there was excellent evidence for drift. Under other, and possibly more average conditions, there was equally good evidence that drift was unimportant. Mrs. Weatherley was now looking into this experimentally at sites down-wind from Hull, to try to define the position more precisely.

Replying to Dr. Gräfe, Dr. Craxford said that, according to the Building Research Station, the amount of coal used per head in the North was greater than that in the South by a much bigger factor than could be accounted for by the colder climate in the North. This was not due to differences in the quality of the coal.

Smokeless Fuels: The Future Supply Position

(1) SOLID SMOKELESS FUELS

by

*F. Wilkinson**

1. Progress of Clean Air

We at the National Coal Board have the cause of clean air very much at heart, and we are disappointed at the slow progress being made in implementing the Clean Air Act. The domestic sections of the Act got off to a slow start. In 1960 and 1962 local authorities submitted phased programmes aimed at covering 2¼ million premises by the end of 1963 and 3¾ million by the end of 1966. We seemed to be making better progress in 1962 and 1963; but even so by the end of June 1964 only about 2 million premises were actually covered by smoke control orders, and it will be at least the end of the year before all these are in operation. Thus, to achieve the 1966 objective, new orders must come forward at the unprecedented rate of nearly 1 million premises a year. But, instead of picking up momentum, progress has fallen off in 1964. In the six months to the end of June, only 119 new proposals for smoke control orders have been brought forward, compared with 225 in the same period last year. This step backwards can only be due to the effect of the Government White Paper "Domestic Fuel Supplies and Clean Air Policy,' (Cmnd. 22
published in December 1963.

This White Paper is a docum
which I am sure will be very famil
to most people attending this C
ference. The main conclusions of t
paper were that while supplies
solid smokeless fuel were adequate
meet the requirements of exist
smoke control orders and confirm
orders which have not yet come i
operation, they would not be suffici
to meet requirements for new smo
control orders for 1965 and beyo
The White Paper estimated that
1970 there would be a shortage
some 600,000 tons of premium react
fuels suitable for any type of op
fire and additionally there would be
shortage of 1·4 million tons of Glo
type gas coke suitable for the improv
open fire, i.e. a total deficit of
million tons of open fire fuel. T
apparent shortfall in open fire suppl
of smokeless fuel prompted t
Government to increase the allowa
for more expensive smokeless
stallations. The effect of this decisi
was to increase the cost of clean air
the Exchequer, to the local author
and to the consumer. In a soci
where the capital claims of so ma
industries and services, housing, pow
stations, hospitals and the like co
pete for a slice of the national cake
almost certainly this would le

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*Member of the Board for Marketing, National Coal Board o a slowing down of the rate of progress in clean air.

Our experience shows that in ouses equipped for solid fuel there s a widespread preference for open res—open fires for heating rooms ither directly or by radiators, or for he dual purpose of heating rooms nd hot water. Such installations re very economic for the consumer, nd their popularity is of profound ignificance for the furtherance of lean air. The capital cost of the pen fire to the Exchequer, to the ocal authority and the consumer is onsiderably smaller than any other ppliance, and this gives enormous otential for stepping up progress ith clean air. For those who want ven greater economy in operation, ogether with much of the heart-arming pleasure of the open fire, here is the room-heater, the open re behind glass which has made remendous strides forward in recent ears and is now such an attractive ocus to the sitting-room.

. Smokeless Fuels for Open Fires and oomheaters

The Board have invested a lot of oney on research and development n fuels for both open fires and room-eaters, and new plants for both are ow under construction. I should ke if I may to give you a progress eport on these plants:-

Homefire. This fuel has been designed especially for the unimproved or improved open fire, and I am sure that many people at this Conference will already have had experience of burning it. In the Homefire process, coal is dried and crushed to below $\frac{1}{16}$ in. in size and carbonized in a fluidized bed at a temperature of 410°C. The char is made into a hexagonal briquette in an extrusion press; no binder is required. The Board have placed a contract for a large plant at Coventry to produce 650,000 tons a year. The plant is expected to be in operation before the winter of 1965/66, and brought up to full production during the next twelve months or so. We intend to market the fuel widely throughout the country. In the meantime the commercial disposals from our small Birch Coppice plant have to be limited to Lancashire, the West Midlands and London.

Roomheat. Since the Government White Paper was published we have developed a new fuel called Roomheat. This is prepared by a similar process to that being used for making Homefire. The coal is prepared, crushed to below $\frac{1}{16}$ in. in size and carbonized in a fluidized bed at a temperature of 450°C. The char is made into cushion briquettes in a roll press; no binder is required. Market trials have been conducted, and the reports are favourable. The fuel is suitable for use in room heaters or the open fire, and we are building a first plant to produce at least 120,000 tons a year at Markham Main colliery in Yorkshire. It will take less than a year to complete. We are also looking for sites for further plants strategically placed in relation to both coal supplies and to the area of maximum demand. They will be on Board property where some of the essential services are already available. In this we will reduce to a minimum the costs of coal preparation and transport and of all the ancillary services. These plants will each have an output capacity of about 100/120,000 tons a year, and are essentially intended to meet local demand where there are likely to be difficulties with solid smokeless fuel. There should also be a larger plant in the Midlands to serve the London area.

In addition to these plans of ours, we expect further developments in the manufacture of open-fire smokeless fuels by private firms making Coalite and Rexco. The White Paper gave the availability of these fuels, based on their plans at the time, as 1·4 m. tons in 1970. I cannot, of course, say just what these two firms will decide—the decisions are theirs—but I can say they are planning to improve very considerably on the figures given in the White Paper, and the National Coal Board is doing all it can to help in providing suitable coal supplies. I can say too that other firms are showing interest in making smokeless fuels. There will be suitable coal available both for the Board's and for the private firms' projects.

3. Smokeless Fuel for Domestic Boilers.

Apart from plans for open fires and roomheaters, there will be further developments in our production of smokeless fuels for use in domestic boilers—developments in the field of naturally smokeless fuels and mild heat treated briquettes:-

Naturally Smokeless Fuels. The availability of naturally smokeless fuels (anthracite and dry steam coals) was given in the White Paper as 2 m. tons a year. We are already seeing a substantial improvement in the production of anthracite, and we expect this to continue. On the basis of current trends and expectations the availability of these naturally smokeless fuels will exceed the estimate of availability given in the White Paper by perhaps ½ m. tons in 1970.

Mild Heat Treated Briquettes. This fuel has been designed principally for use in domestic boilers, and resembles Phurnacite. In this process we use a blend of 85 per cent anthracite duff and 9 per cent coking smalls previously crushed and dried, and a pitch binder. The briquettes will be made smokeless by mild heat treatment (M.H.T.) in a sand bed. Market trials show that this fuel also gives good results both in open fires and room heaters. We plan to build a plant initially with a capacity of 110,000 tons a year, capable of expansion up to 330,000 tons a year, on the site of the Crown Patent Fuel works Cardiff. We expect that, Phurnacite, the principal mar outlet for this fuel will be London and the South.

4. Future Supply Prospects

In the light of these developme let us now look at prospects in 1 compared with the estimates set in the White Paper. The W Paper estimated that the demand solid smokeless fuels in 1970 would to 11¼ m. tons, but that availa supplies would total only sligh more than 9½ m. tons. Developme in the Board's and other produc plans since the White Paper prepared have invalidated this fig of availability. In the next two ye the National Coal Board alone be putting well over 1 m. tons m solid smokeless fuels on the mar per year. A wider range of coals been proved suitable for the fluidi bed process, and with the except of the Coventry plant our fut expansion plans will be based mai on Roomheat, which is suitable both the open fire and closed ap ances. Roomheat plants take than a year to complete, and o the first plant has been proved, ot plants can be brought in as dema warrants. These, together with expansion plans of the independ producers, will ensure that fr 1965/66 onwards, supplies of sc smokeless fuels will be very c siderably greater than the estim given in the White Paper. Inde there will be no shortage of th fuels for either open fires or clo appliances.

5. Consumer's Choice

(i) *Building Practice*

A number of new dwelli now being built arbitrarily restr the consumer to the use of fuel for the lifetime of the dwelli If a consumer is to have freed of choice of fuel—a freed which enables him to adapt fuel usage to his changing circu stances of living—it is essen that flues should be provided in all new buildings, flues capable of accommodating either open or closed appliances to take up the smokeless fuels which we and others are doing so much to provide.

(ii) *Appliance Development*

In this field of domestic heating the individual consumer's choice is the ultimate arbiter of the fuel used. To widen the field of choice the board, in partnership with appliance manufacturers, have directed their efforts to the development of a wide range of smokeless appliances. Immense progress has been made in the design and provision of partial and full central heating systems for all types and sizes of homes using a wide variety of fuels. It is a matter of great satisfaction to me that some 114,000 of the new central heating installations in 1962, and about 200,000 of the 400,000 systems installed in 1963 were solid fuel fired. Innovations are continually being introduced to widen the range of fuel used and the styling and consumer appeal of all domestic appliances, whether they be open fires, sitting-room boilers or advanced room heaters. Our efforts are directed not merely at producing and burning smokeless fuel; considerable emphasis is also placed in our programme on production of appliances to burn bituminous fuel smokelessly. Indeed, in co-operation with the appliances manufacturers, one such central heating system is already on the market. This is an underfeed stoker using bituminous singles. Our research is continuing, to see whether we can apply the same principle to room heaters.

(iii) *Prices*

The ultimate success or failure of these solid fuel systems will depend to a large degree on the prices of the fuels. In the case of Phurnacite and the naturally smokeless fuels produced by the Board—anthracite, dry steam coals—prices have been kept steady for quite a time. As regards coke, you will know from the White Paper that in 1962 the Board was making heavy losses at its coke ovens. We could not go on doing this and at the same time meet the financial obligations that Parliament has placed upon us. The object of our increase in Sunbrite prices this year—the first increase since September 1960—was to bring prices more into line with costs, improve the economics of the plants and so make the output more secure. One of the effects of this increase has been to bring the price of domestic and industrial coke much nearer the price of coke to the blast furnace—thus encouraging integrated iron and steel works with idle or under-used coke oven capacity to enter the domestic market and further increase the availability of smokeless fuel. Moreover, this modest increase in the price of Sunbrite does not vitiate the cost comparisons made in Appendix 3 of the White Paper—where hard coke (Sunbrite) was a handsome winner on cost. As for premium open fire fuels, whilst their cost per ton is higher than the ordinary gas or hard coke, their superior quality—in ash content, reactivity and capacity for slow burning—makes them an attractive buy for the consumer. At the same time, provided these premium fuels are used in an appliance with efficient controls, they will be little, if any, more expensive to use than the cheaper fuels which do not react so readily to draught control.

6. Conclusion

The Board have long been active in the pursuit of clean air—indeed, our Stoke Orchard Research Establishment started its investigations into the production of smokeless fuels in the early 1950's. We have no vested interest in selling dark smoke to pollute the atmosphere; indeed, such is the scale of our investment in smokeless fuels that our vested interests lie in promoting clean air. The main impact of the White Paper and the associated Ministry of Housing Circular is doubly unfortunate. They have reduced the rate of progress of introducing smoke control at a time when there were clear signs that local authorities—under the stimulus of this Society and other interested bodies—were quickening the rate of introduction of new smoke control orders. On the basis of the developments and expansion plans which I have outlined above, there is no justification for slowing down any introduction of smoke control orders on the grounds of inadequate supplies of suitable fuels. Proposals being put forward now will be coming into operation in 1966 at a time when our own big plants, like Coventry, will be coming on full stream, and the expansion plans of independent producers will also be contributing greatly increased supplies. It is important, therefore, that local authorities in black areas are made aware that the estimated shortfalls envisaged by the White Paper are no longer valid and that so far as we can see ahead there should be no difficulties in meeting the requirements of an accelerated rate of smoke control.

(2) OIL

by

E. Rendall, M.Inst.F., M.Inst.Pet.[*]

IN the conclusions of the Government White Paper on domestic fuel supplies and clean air policy it is stated that gas, oil and off-peak electricity provide acceptable alternatives to solid fuel for a large proportion of householders in smoke-control areas. Oil has been regarded as a suitable fuel for use in these areas ever since the issue of Statutory Instrument 541 in 1957 which exempted oil burning equipment from the provisions of Section II of the Clean Air Act. But it is only in the last year that changes in the prospects for future supplies of solid smokeless fuels have emphasized the essential role of oil fuels in ensuring the continued implementation of the intentions of the Clean Air Act.

Quite apart from technical considerations concerning the fuel itself, oil differs from solid smokeless fuels, gas and electricity in that the supplying industry is international in character (and incidentally involves considerably more competition). About 40 per cent of all the energy used in the world today is derived from oil, and any consideration of the availability of oil fuel in this country must therefore be related to world fuel production and consumption, and to some approximation of the fuel reserves which are known, or may be estimated to exist.

The pessimists have been declaring for a long time now that oil supplies will run out, yet year after year the demand increases, and still today the reserves are as healthy as ever—a fact which is undoubtedly to the credit of those sections of the oil industry who explore and prospect for new wells, and develop new techniques for extracting more oil from existing wells. A recent estimate of reserves, making allowance for increasing usage of oil fuels, showed a comfortable supply position well into the next century. It is very interesting to look at the annual oil production figures over the last few years, and to compare these with the reserves at the end of the years. In 1938 world production stood at 268 million tons, and the proven reserves at the end of the year were 4,585 million tons. By 1953 the world production rate had increased to 648 million tons, but the proven reserves at the end of the year stood at 18,145 million tons. By 1963 world production had risen to 1,292 million tons and the proven reserves at the end of that year stood at 44,075 million tons.

This glance at the future has taken no account of the "tar sands" and oil shales, enormous deposits which due to technical difficulties have not proved economical to exploit up to the present time. Already, however, plans have been approved for the first commercial development of the enormous fuel reserves in the Athabasca tar sands in Canada. The Alberta Oil and Gas Conservation Board have approved an application by Great Canadian Oil Sands Limited to start production of about 6,300 tons per day. Cities Service Athabasca and Shell Canadian both have plans for 14,000 tons per day production from these tar sands. Another source or oil not often discussed in Europe is the Green River shale deposits in Colorado, Utah and Wyoming. Conservative estimates place the shale oil content at 180,000 million tons. A reasonable estimate of recovery of 70 per cent would yield at least 133,000 million tons, this being about three times the total proved crude reserves of the entire world. It has been rumoured that a shale oil industry is imminent in the U.S.A. and that production might start around 1970.

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[*]General Manager, Industrial Sales, Shell-Mex and B.P. Ltd.

With this background of world-wide fuel availability, and the wide distribution of sources from which crude supplies are brought to this country, the oil industry can be fully assured of the continuity of supplies of all grades of fuel from its U.K. refineries. The industry can therefore read the Ministry of Housing and Local Government circular on Smoke Control Areas and the Availability of Smokeless Fuels—which spoke in terms of the next decade—with complete confidence.

For a long time the U.K. has been a leading user of petroleum products, and in recent years the demand has increased greatly. Back in the thirties, fully refined products were imported as required, and distributed (often in small loads) to the consumer. The changing pattern of demand has necessitated a greater flexibility of distribution, and this is based upon refining in the marketing area, as opposed to the area of production from oil wells. There are now a number of refineries around our coasts which process crudes into the products required for the U.K. markets. In less than 30 years the country's refining capacity has increased by more than twenty-fold, and is still increasing.

In June two oil companies announced their intention to build large oil refineries in this country and provided the latest indication that the U.K. refining industry has begun a further period of rapid expansion that will last for several years. Earlier in the year two other companies have made similar announcements; quite recently a new refinery costing £7 million has been opened in Northern Ireland, and in the autumn a £20 million refinery at Milford Haven will come on stream.

The investment of such enormous sums of money by the oil industry is a very good indication of the confidence which it places in the future of supplies and is a good example of the long-term planning which typifies the oil industry.

Distribution

From the strategically placed refineries around our coasts, finished products are sent by road, rail or coastal tanker direct to customers; or to installations and depots throughout the country where they are stored in readiness for supply to customers by local delivery vehicles.

Most of the major oil companies have what they call Authorised Distributors. These local distributors specialize in deliveries to particular classes of customer, of which the domestic market is perhaps the most important. In the context of this meeting we are particularly interested in one fraction of the market for petroleum products—domestic oil fuels for the householder, particularly for those living, or about to be included, in smoke control areas. The fuels concerned are premium grade paraffin for room heaters; a light distillate oil for fluid convectors, air heaters and small boilers; and thirdly, a slightly heavier distillate fuel, commonly known as Domestic Fuel Oil. This latter grade is used for medium and large sized domestic central heating plant.

Incidentally, it is perhaps worth mentioning the combustion standards that may be expected with domestic oil burning equipment. There is no ash in the fuel, so there is no grit or dust emission.

For the successful operation of the equipment, completely clean combustion is essential. This is more than saying "there is no visible smoke"— it means that the equipment will operate so as to produce virtually no stain on a filter paper through which a standard quantity of the flue gas is passed using the very sensitive test which is standard in our industry. And remember that the fuels used in domestic premises (where all the low level chimneys are to be found) have very low sulphur contents—below 0·8 per cent for domestic fuel, and less than 0·2 per cent for the widely used light domestic fuel. The sulphur content of burning oil for paraffin heaters is, of course, negligible. The generally accepted average figure for solid fuels is 1·6 per cent.

The non-flued room heaters are usually referred to as "paraffin heaters" and it is perhaps in connection with these appliances that the oil industry can make the greatest *immediate* contribution with a fuel for smoke control areas. There are indeed over eight million of these heaters in use today, whereas in the early fifties the "heater population" was estimated at about one million; such has been the popularity of this method of heating. Last year nearly 350 million gallons of fuel were supplied for this class of heater.

This fuel—premium paraffin (with famous colours!)—has been designed especially for the job of producing heat cleanly, efficiently, and odourlessly. It is a highly refined product, and must conform to a stringent specification—yet the cost is not high. I would draw your attention to the average weekly fuel costs given in the White Paper on "Domestic Fuel Supplies and the Clean Air Policy" and also to the retail price indices of domestic fuels given in Appendix II. These show that the change in cost of paraffin since 1954 is only 16 per cent and this includes a tax imposition!

Throughout the country there is a special paraffin delivery service, operated by selected retailers, who make door to door deliveries; so the obtaining of paraffin by the housewife is a very simple matter. Coin-in-the-slot vending machines have already made a limited appearance for the convenience of the customer wanting supplies outside normal working hours.

There is a very wide choice of appliances using paraffin, and they are designed to be attractive as well as functional. All new heaters conform to the Oil Heaters Regulations 1962, which resulted from the Oil Burners (Standards) Bill of 1960. The regulations make it an offence to sell heaters that do not conform with the specified requirements—the Local Authority is the enforcing body under the Act. The requirements are incorporated in British Standard 3300: 1960, which is undoubtedly the most demanding standard set in the world for this type of equipment. Recent official comments in White Papers have made it clear that paraffin heaters can qualify for Clean Air grants provided they are fixed (and the Regulations make it mandatory for heaters to be manufactured with adequate provision for such fixing).

The Flued Appliance

Let us now turn to the more sophisticated forms of heating, and firstly to the flued appliance. It was the oil industry which first generated the mass market for central heating in the home, and the oil fired boiler (of which there are many types, efficient, automatically controlled, and attractive in design) is commonplace today. There is unquestionably a great public interest in, and demand for, better heating standards in our homes today, for which we are perhaps indebted to the rigours of the 1962 winter! We have shivered under almost primitive heating systems for too long, and it is encouraging to all of us today that these demands, and this interest, exist.

Flued appliances include not only the domestic boiler, but the oil fired air heater, which may appear in a number of forms. Relatively small flued convectors may replace the normal grate and will heat not only the room in which they are situated but also the hall, stairway and rooms above by the flow of warm air. Centrally sited warm air units may be installed where the warm air is ducted throughout the house giving comfortable conditions in all rooms. Many air heater units are so designed as to provide a supply of domestic hot water in addition to the heating air; the modern design and construction techniques make it possible to install complete prefabricated units in new property.

The choice of fuel for boilers and

flued air heaters depends upon the thermal output of the unit. In all cases it is a highly refined distillate which conforms to stringent specifications. Distribution is usually through the oil companies' authorized distributors—to whom I have already referred—and who, to assist the householder, provide what is called planned delivery and planned payment; the former relieves the householder of the responsibility of ordering supplies, and the latter spreads the burden of payment for winter fuel supplies over the whole of the year. A number of these distributors also provide a planned maintenance scheme to ensure efficient trouble-free operation.

One other recent development in the oil central heating market which I think I should mention, is the method of Central Oil Distribution, which provides for oil feed to houses, or flats on an estate from a centrally disposed bulk oil storage. The quantity used by the boiler in each dwelling is measured by a meter and the householder charged accordingly. This method of supplying heating to groups of houses is likely to prove of considerable interest to local authorities in the future.

The conclusions of the Government White Paper state that the gas, oil and electricity industries should have little difficulty in expanding to meet shortfalls in solid smokeless fuels. That the oil industry will have no difficulty in making its contribution is, I am confident, beyond doubt. The fuel is there, a wide range of equipment is available to use the fuel, and there is an efficient distribution network throughout the country to convey the fuel to the householder.

(3) GAS

by

*Sir Henry Jones, M.B.E.**

I AM very grateful to your President for the opportunity to address this Conference. As the producer of gas and of gas coke the gas industry has taken a leading part in the early stages of the development of clean air under provisions of the 1956 Act. I believe that now, with the revised grant arrangements after the Government's White Paper and the growing demand for a better standard of living and a higher degree of comfort in the home, there is every chance that the modest rate of progress of the past years, particularly in the domestic sector, will be followed by a more rapid spread of clean air.

It was not to be expected that the passing of a statute would alter the personal preferences of people or force a willing acceptance of something new. Once technical problems are solved, advance depends on making the change acceptable by the communication of ideas and by honest persuasion. In the home, man, especially perhaps the *Englishman* (or woman for that matter), tends to preserve the environment he is accustomed to and may often resist the intrusion of outside influences. But since the mid-fifties two important sources of communication particularly well placed to penetrate the home have grown significantly. The number of television sets in the United Kingdom measured, perhaps conservatively, by the number of licences taken out, grew from 4½ million at the end of March, 1955 to very nearly 13 million at the end of May 1964. Also, consumption of newsprint in the U.K. rose by roughly 50 per cent over a similar period. The opportunity for spreading new information is thus considerably larger now than in the mid-fifties and new ideas can reach wide audiences swiftly, as we in the gas industry have found in the past few years.

Greater speed and ease of communication have encouraged new ideas about housing and home life. Often both wife and husband are at work and there is little time for household chores. The advantages of a labour saving "automatic" fuel, a clean fuel which reduces house cleaning to a minimum are therefore of special value. At the same time higher standards of warmth and comfort are being sought and the necessary costs are accepted. One measure of the change taking place in the domestic sector is the rise in real incomes. Since 1955 personal disposable incomes have risen by more than 20 per cent and a rising percentage has been put into personal savings. More people than ever before are willing to spend more money on making their homes warmer and more comfortable.

I shall not be accused of playing at party politics if I say that as a matter of national policy it is intended that the rise in real incomes shall continue; and if this is true the rise in expenditure on home heating equipment will continue too.

Another measure of the change in the domestic situation is the increasing clearance of slums and the rate at which houses are expected to become obsolete. One recent survey by the Town and Country Planning Association quoted the recent increase in the rate of demolition of unfit houses. The rate of obsolescence in housing is expected to continue to rise over the next 30 years; indeed, the National Economic Development Office in its Report on the "Growth of the Economy to 1966" published last year pointed out that some experts had put the desirable rate of replacement of houses in the United Kingdom at 200,000 a year—nearly three times the present rate. The higher standards likely to be demanded in houses of the future can be illustrated by the growing sales of domestic heating appliances: the same Town and Country Planning Survey I mentioned a moment ago estimated that of all the houses and flats built between 1972 and 1982, 85 per cent would have *full* central heating installations.

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* Chairman, The Gas Council

All this is going to mean greater demands for fuel in an acceptable form, even with all the benefits of better installation and higher efficiency. It also bodes well for the future spread of clean air, provided householders make the right choice of fuel. Gas, of course, can fulfil the domestic demands for fuel with minimum pollution of the air. It does not "pollute" air: it merely uses oxygen and produces water and carbon dioxide—as we all do when we breathe. (I might also add that pipelines to distribute the gas are out of sight once they are laid). Already gas is making a valuable contribution to the spread of clean air in the domestic sector: 750,000 gas space heaters were sold in the year ending March 31, 1964; six years ago annual sales were only 125,000. Also during 1963/64 some 90,000 gas fired full central heating systems were installed, a rise of 61 per cent over the previous year. Our latest figures show that the sales of gas heating equipment are still rising strongly.

The making of gas, too, in gas works of modern pattern does not pollute air to any significant extent. The furnaces burn only a small part of the raw materials, and these are almost invariably feedstocks with a relatively low sulphur content.

Progress in the industry's research has produced even newer processes than the I.C.I. reforming system which is now being widely used. Especially important for the domestic heating load, the new processes have low capital costs and can be used economically to meet growing winter peak heating loads. These reformers will take an increasing share of total gas supplied as new plant is rapidly installed, and to meet the rising demands for gas the capital expenditure programmes of the industry have been increased. Last year, that is in the year ending March 31, 1964, gas production capacity rose by 10 per cent.

Total sales of gas coke, unlike those of gas, have been falling whilst stocks have been building up. Production is less because, as is common knowledge, it has become cheaper to make gas by oil reforming than by coal carbonization; but in any case, with falling sales of coke and increasing stocks, production would have had to be curtailed. However, the overall figures for gas coke have been reflecting considerable reductions in the use of gas coke by industry. From the point of view of clean air those relating to the open fire fuels, Gloco, Sebrite, Cleanglow and Phimax, are of more interest, and these are believed to have been maintained.

In 1963 the White Paper on Domestic Fuel Supplies and the Clean Air Policy (Cmnd. 2231) set out the consumption of solid fuel in the domestic market from 1950 to 1962 and gave estimates for the future demand for solid smokeless fuel and the availability of fuels to meet it. In Table II of Appendix I of the White Paper supplies of Cleanglow and Phimax are shown as increasing from 735,000 tons in 1962 to 800,000 tons in 1970. Supplies of Gloco (including Sebrite) are shown to fall from 2·6 million tons in 1962 to 1·9 million tons in 1970. But over the same period the grand total of available solid smokeless fuel is shown as rising from nearly 7 million tons to 9·65 million tons.

1970 is some way ahead. New processes for gas making and the availability of natural gas may lead to coke production falling more rapidly than hitherto. On the other hand new processes, such as those of e National Coal Board, for making lid smokeless fuels will be introduced fore then. One can only estimate ead for a limited period. But, as today I can say that stocks of gas ke exceed 2 million tons, more than 0,000 tons of which are of domestic en fire quality. We foresee no fficulty in meeting the demand r coke next winter. We believe that the long term gas will become so opular for domestic heating that e market for solid smokeless fuel ill be capable of being fully supplied otwithstanding the reduction in the pply of gas coke.

With all the resources of smokeless els that are, and will be available, do not believe that any general ortage will develop. However, with 50 gas works today, as against ,050 in 1949, gas coke cannot be ade available everywhere. Customers ust be willing to "shop around" and, they cannot get one kind of smoke- ss fuel locally, try another. We elieve that gas is the best of all and e were naturally very pleased that llowing the publication of the White aper to which I have referred, the overnment extended the grant pro- sions of the Clean Air Act to gas urning appliances. I hope that local uthorities will take the widest advan- ge of this enlightened change in the fficial attitude to smokeless fuels.

I have said that it is hard to see head even to 1970, but I have been lking of developments in home eating to the 1980's and beyond. What of the gas supply then? The ultimate possibility is that 100 per cent natural gas may be distributed instead of town gas as we know it today. So far there is little natural gas in Britain, but this year the industry is pioneering the supply of natural gas from the Sahara to eight Area Gas Boards. The annual quantity of the Saharan supply will provide about 10 per cent of gas supplied, and will be reformed or mixed with other gas before reaching consumers. Prospects of much larger supplies, which might make it worthwhile to distribute natural gas direct to consumers, have arisen as the result of the Dutch discoveries and the surveys in the North Sea. It is too early yet to say whether supplies will be available from Holland or found in the North Sea, but we are hopeful; and even if we are eventually disappointed the new steam reformers can ensure good gas supplies for Britain.

Whatever the sources of gas in the future, the industry should be well placed to supply a greater share of the fuel market, indeed, it is already being called upon to do so. Demand for gas is estimated to have risen, after allowing for the effect of temperatures, by 1 per cent in 1961/62, by 3 per cent in 1962/63, and by 5 per cent in 1963/64. Provided the householder gets a free and equal choice of fuels and appliances in smoke control areas the gas industry will look forward to continuing its major support of the spread of clean air.

(4) ELECTRICITY

by

*C. T. Melling, C.B.E., M.Sc.Tech., F.Inst.F.**

THERE has been a spectacular increase in the domestic use of electricity during the last few years. In the eight years 1955 to 1963, the amount of electricity used for domestic heating of rooms and buildings increased by over 200 per cent. The percentage of consumers in England and Wales using electric cookers increased from 24·5 to 32 per cent; electric water heaters from 21 to 42 per cent; electric washing machines from 17·5 to 50 per cent; and electric refrigerators from 8 to 33 per cent. In that same period the average use per domestic consumer of electricity for all purposes increased from 1,520 to 3,018 units per annum.

This increase in the demand by householders for electricity brought problems to Electricity Boards. In the winter of 1962/63, the increase was particularly high and caused overloading of generating stations and distribution systems, resulting in a small percentage of consumers suffering breakdowns of supply and load shedding.

The demand for electricity continues to increase but, having in mind the winter experience of nearly two years ago, consumers who are anxious to purchase electrical appliances are even more anxious to receive assurance that a reliable supply of electricity will be available.

In re-assuring consumers, let me deal first with the nature of winter shortages. The peak demand usually occurs at 5.30 p.m. on a cold January weekday, with an overlapping of the demands of domestic, commercial, and industrial consumers. When the weather is particularly cold the demand is particularly high—the colder the weather the greater the use of electric heating and the higher the peak demand.

Two years ago at this time we were facing a winter which turned out to be the coldest for over 200 years and we were facing it, moreover, with very small reserves of generating plant. These two facts, together with industrial trouble, resulted in load shedding in January, 1963, the first since 1956. Fortunately, this load shedding affected only a small percentage of consumers.

In order to provide a reliable supply of electricity, we had planned to have a margin of 14 per cent of generating plant to meet contingencies of breakdown, exceptionally cold weather, and excessively high demands over the forecast made six years earlier. (This long-term forecasting is necessary because of the time needed to plan, obtain consents for sites, manufacture turbines, generators, boilers, and build new power stations).

This time last year we faced the winter with a generating plant margin of only about 5 per cent instead of 14 per cent because demand was still increasing at a higher rate than we had estimated earlier but, fortunately, with improved operating techniques and a winter which was not colder than average, supplies of electricity were maintained throughout the winter without any load shedding.

This coming winter, unless the weather is exceptionally severe, I anticipate that, once more, there will be no load shedding. Supplies for next year and the future will be provided from a generating system with an increasing margin to meet contingencies. There is a very large programme to increase the generating capacity of the country's power stations and by 1970 the total

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* Deputy Chairman, The Electricity Council.

pacity of the generating stations will
ave been doubled. This programme
ticipates a continuation of the
esent rapid increase in demand for
ectricity and, moreover, provides for
increase from 14 to 17 per cent in
e planned margin of generating
ant. In this and other ways we are
oviding reliable supplies to meet the
pidly growing demands for electricity.

Let me say a special word, however,
bout Christmas Day 1961 and 1962.
dustry takes about half the electricity
nerated in Great Britain and at
hristmas the industrial demand is
ways very small and there is adequate
nerating capacity. Shortages at
hristmas 1961 and 1962 were not at
e generating stations but at the local
stribution systems. Local cables and
b-stations were heavily overloaded
d a few of them broke down. This
fected the supplies to between 1 and
per cent of consumers.

All this is because the domestic
mand at Christmas is particularly
gh. May I express it as the inter-
lationship of the use of electricity and
heerfulness". The domestic demand
r electricity at Christmas is always
gher than at any other time of the
ar and this is usually met without
fficulty. Christmas 1961 and 1962
mands, however, were particularly
gh because those two Christmas
ays were very cold; the temperature
as very much below the average
hristmas Day temperature. In fact,
ey were colder than any Christmas
ay in the previous century so that,
addition to the normal Christmas
ad, householders made a much
eater use of electric fires and other
ectric heaters to supplement their
rmal heating arrangements and the
stribution systems were in some
ses inadequate—inadequate because,
er many years, there had been in-
fficient capital for their reinforce-
ent to meet rapidly increasing
mands which exceeded even our
ost optimistic anticipations.

The first thing to do, therefore, was
carry out first-aid measures and get
d of the particular weaknesses in the
stribution systems. This has been done. Then, recognizing that the increase in demand for electricity is continuing and will continue and that our distribution networks must carry much larger domestic loads than at present, a systematic increase was made in the standards of capacity and reliability.

Distribution networks have now been strengthened and reinforcement is continuing so that cables and substations can carry heavier winter loads. There will not be a repetition of Christmas 1961 and 1962 circumstances even if the temperature should be the lowest for 100 or even 200 years!

The increase of electricity usage in households has been accompanied by gradual changes in the nature of the use. Improvements have been made in appliances and methods of applying electricity to domestic purposes and one of the principal improvements is in the use of off-peak electricity for the heating of rooms and buildings. This is no new thing—off-peak heating was used in a few particular instances about forty years ago—but it is only in the last few years that it has been developed for convenient application in the home.

Cheap off-peak supplies offered by all Electricity Boards—in many cases about half the normal price—are possible because demands limited to off-peak periods can be met without incurring additional capital expenditure on generating plant.

There are two general methods of using off-peak supplies. The first is by floor warming where cables are embedded in concrete floors and provide a substantial heat reservoir. Although this method is applicable to new buildings, it is not so readily used for existing buildings. For these, as well as for new buildings if so desired, there are "unit plan" heaters, i.e. storage heaters which may be added to or moved, taking supplies during off-peak hours only. Some of them release heat continuously, while others are fan-controlled to give a quick rise of temperature of the room whenever needed (and to avoid emitting heat when not required).

A householder may install one or more unit plan heaters depending on his requirements, and by this means may obtain his electrical central heating system in easy stages.

It was only two years ago that purchase tax on this form of central heating was abolished. In the year 1962/63 about 150,000 unit plan heaters were installed and in the following year over 250,000, i.e., about 100,000 consumers installed unit plan heaters in that year.

By the way, about a year ago, it was rumoured that supplies of electricity for the "afternoon boost" would cease to be available before long. This rumour was emphatically denied by the Chairman of the Electricity Council.

Yesterday, however, I heard that the rumour had been re-started. Let me, therefore, assure all Local Authorities and all consumers of electricity that an "afternoon boost" will continue to be available on off-peak tariffs for all unit plan heaters which have already been bought or which will be bought in the foreseeable future and that the prices on off-peak tariffs will continue to be attractive.

In order to learn as much as possible about consumers' reactions to the heaters, the Electricity Council commissioned a Market Research organization to make a survey in the spring of 1963. This survey was repeated in Spring of this year and it was pleasing to find that in both years about 95 per cent of the consumers who had purchased unit plan heaters were satisfied with them. Approximately 75 per cent of those who had purchased them had recommended them to their friends and many of the sales last winter resulted from recommendations given by consumers who had bought unit plan heaters in the previous winter. Electricity Boards, contractors, and manufacturers have been encouraged by these results. More pleasing designs of heaters are now offered at lower prices and a sharp increase in sales is anticipated.

The design of a heating installation for a house, however, is more than the design of the appliances themselves and Electricity Boards have produced manuals and organized training courses in order to increase the number and skill of people engaged on electric heating installations. The knowledge and skill of the representatives concerned is important because unit plan heaters may be used in a variety of ways. At the one extreme they may be used to give a low temperature background heating, augmented by other forms of heaters or, at the other extreme, they may be used for the full heating of a room or a house.

The size and nature of the installation depends on the consumer's requirements and Electricity Boards and electrical contractors will provide the installation required—whether it be desired to have, say, a full heating service in a main living room as in clean air zones, or background heating of a house.

From the consumer's viewpoint, an installation consisting of unit plan heating in the main living room, with fixed electric fires in other rooms, is very appropriate. Fixed electric fires are not expensive and intermittent electric heating of subsidiary living rooms and bedrooms meets the consumer's requirements for comfort, with economy, in those rooms.

From the Electricity Boards' viewpoint, such an installation is a desirable load because, while a material proportion of electric fires in main living rooms is likely to be in use at the time of the system peak, this is not so in the case of fixed electric fires in other rooms. Electricity Boards, therefore, welcome this form of heating installation—unit plan heaters in main living rooms; fixed electric fires in other rooms.

But now a word about price. Consumers and local authorities are not going to be satisfied with reliable supplies if the price is high. During the last year or so, some Area Electricity Boards have had to increase their domestic tariffs, partly to meet the rising costs, partly because of the requirement that Boards shall make a higher return on net assets employed and partly to correct an imbalance in some elements of the tariffs. (Increases in off-peak tariffs, however, have been comparatively small). In some cases, the final unit charges which may well have been correct when the tariffs were first devised had become uneconomic with increased costs. Price increases naturally caused concern to the people affected by them. The concern about tariff increases was probably because the increases in price of electricity over several years had been small—less than for other commodities and services.

But consumers naturally wish to have assurance about the future trend of prices. In times of inflation, it is very difficult to make forecasts about prices. The principal anomalies in domestic tariffs have now been corrected, or are in the process of being corrected, and I think that over the years ahead the ratio of average domestic price for electricity to the retail price index should be relatively stable. Of course, we are concerned here principally with clear air zones and the electric heating of houses in these zones will be carried out largely on off-peak tariffs for the unit plan storage heaters. Tariff increases have occurred less in off-peak tariffs than in the general tariffs. Off-peak tariffs are, in fact, now more favourable in relation to general tariffs than at any time in the past and I would expect that this favourable relationship will persist in view of the continuing improvement in the thermal efficiency of generating stations.

These improvements stem from two things—firstly the economy of size in generating plant. In 1952, the usual size of generating plant was 30,000 or 60,000 kW sets. The standard size now being ordered (but not yet installed) is 500,000 kW and the resulting economy is shown by their relative capital costs as well as by their thermal efficiencies. In 1952 the capital cost was about £65 per kW. Under present conditions the capital cost is about £37 per kW and this reduction is in spite of the very considerable increases in the cost of materials and labour. Secondly, there is the economy resulting from the technological developments such as higher steam temperatures and pressures producing higher thermal efficiencies. The new standard generating sets will produce about 30 per cent more electricity per pound of coal than those installed in 1952.

These economies in the generation of electricity are, indeed, outstanding but economies have also been made in the distribution of electricity by improved planning and construction of networks and improvements in the individual pieces of engineering machinery and equipment. Improvements in technology, however, are not merely a question of improving existing techniques. In engineering, there is always the possibility of new techniques, the application of new scientific discoveries to engineering practice and, with the rapidly increasing capital expenditure of the industry—at the present time about £600 million per annum—we are examining every aspect of our work to see how effectively new methods and, indeed, new scientific principles, can be applied. In the last seven years, three large new research laboratories have been built and a very high level of scientific staff recruited for research in generation, transmission, distribution, and utilization of electricity. The work of the physicist, chemist, mathematician, biologist, economist, and statistician has all been mobilized in the search for greater efficiency and economy. Large-scale research programmes have been formulated in both conventional engineering work and that associated with newer branches such as nuclear generating stations. A particularly interesting programme, which it is hoped will result in very considerable improvements in generating efficiency, is that recently announced on magnetohydrodynamics where an expenditure of approximately £2 million on research is considered amply justified in view of the possibilities of greater economy in the production of electricity.

To summarize, therefore—I feel satisfied that we will meet the increasing demands for electricity with an abundant and reliable supply at competitive prices to the satisfaction of consumers in clean air zones and throughout the country.

Discussion

E. M. Birtwisle (Horsforth) in opening the discussion said he supposed Mr. Wilkinson came to the Conference anticipating criticism of the Coal Board and felt it was better to attack than to go on to the defensive, by suggesting that the real nigger in the woodpile during 1964 was the White Paper produced by the Minister of Power. In fact, the Minister of Power was the most innocent of the parties that had been concerned in the slowing down of smoke control programmes. Mr. Wilkinson had made what was to most present the startling suggestion that the pattern of house heating in the future was the open fire. The Coal Board claimed to have invested a tremendous amount of money in producing open fire fuels, and so it was appropriate that Mr. Wilkinson should tell the Conference that the pattern of the future was the open fire. People in the clean air movement had no special preference for any form of heating provided it was smokeless and there were adequate supplies for those who wanted to use it.

Mr. Wilkinson's paper suggested that local authorities had been wrong in changing their ideas and to slow down their work because ample supplies of open fire fuels were available. They knew that gas coke production had slowed down and the Coal Board had told them they would be able to rely on Homefire by 1967, Roomheat would be available in some fairly small quantities next year. In the meantime local authorities were making orders on the basis of Sunbrite and he thought it was remarkable that Mr. Mr. Wilkinson's paper made no reference to the new boiler fuel which would be available in London and the South. Would it be available in the North of England or were local authorities to rely on supplies of Sunbrite? Assurance would be needed on the availability of this fuel not just from the stock piles that had been accumulated by the Coal Board but as a continuing product.

New appliances to burn raw coal smokelessly had been mentioned as part of the National Coal Board's research programme. Such appliances would be welcomed but a note of warning should be given. It was one thing to design appliances to burn smokelessly but if they got into the hands of people who did not understand them they could produce that telltale pall of smoke which did the Coal Board no good at all. Mr. Wilkinson's conclusions were also puzzling to local authority representatives who had spent the last 18 months trying to reorganize their smoke control area work so that Sunbrite could be burned and the Coal Board made happy. Now there was a suggestion that they were producing difficulties for the solid fuel industries because they were not getting along well enough. Mr. Birtwisle said he felt that the blame should be apportioned elsewhere. Regarding other fuel industries there was not a great deal that one had to be critical about as they were producing fuels which more readily adapted themselves to clean air work. The Electricity Board had to be unique as an industry and at the same time the envy of all industrialists for being able to sell more than they wanted to produce. If the Electricity Board were to go forward they had to get over to the public the ideal conditions that could be created by the use of storage heaters. The Englishman, or rather his wife, was very reluctant to have invisible heating and not see flames dancing before their eyes. The whole basis for dealing with those other fuel industries was that we had to alter our pattern of living to fit the best methods of utilizing such fuels.

Mr. Birtwisle went on to say he welcomed the prospect of the oil industry providing low sulphur content oils in the domestic field. Mr. Rendall had given an assurance about this and one would like to see it spreading to the industrial field. The earlier generations had seen the gas industry encouraging the use of that rather unfavourable product coke which had become so valuable with the passing of the years. The gas industry had been one of the close friends of the clean air movement and they had a remarkable facility of always being ready with something new just around the corner when the moment occurred and had even timed deliveries of Sahara gas so that Sir Henry Jones could announce its arrival to the Conference that morning. But the crisis in clean air was precipitated by the gas industry giving up coke making and he marvelled at the way they had been able to gloss over that situation.

Mr. Birtwisle concluded by saying that the clean air movement was not critical of the solid fuel industries, but would say to them that they were not "with it". In many instances they had not accepted the fact that the householder was not so interested in clean air as in the more efficient labour-saving forms of heating; this and not cheapness was the paramount consideration. If in the future the solid fuel industries found that their sales were declining they would have to blame themselves and not the trend towards clean air.

M. Graham (Community Council of Lancashire) said that any appliance that relieved the pressure on solid smokeless fuels was of national value. Utility gas room heaters, retailing around £15, should not, in the view of his Council, carry £2 8s. purchase tax as this placed an undue burden on old people who depended on such fires as the most adequate substitute for the old open fire to which they had been accustomed.

Councillor D. Gray (Solihull) referred to the shortage of solid smokeless fuels in the Midland area. He felt that the Midland Gas Board were deliberately increasing the price of coke to deter people from using it, and that old age pensioners and others were being forced to purchase at the local ironmonger as and when it was needed, pre-packed fuels at considerably increased prices. People were being deterred from installing central heating because it increased the rateable value of the property thereby increasing rates. An integration of ideas by the various fuel industries was required to achieve a national fuel policy that would ensure the speedier implementation of the Clean Air Act. In Solihull, the smokeless zone programme had been delayed for 18 months because of a shortage of solid smokeless fuels.

R. A. Newton (Lambeth) inquired who had advised the Minister of Power in his preparation of the "notorious" White Paper. It was now being said that the shortage of "open fire" fuels, envisaged in the Paper and Circular 69/63, would not occur. He thought Mr. Randall was glossing over the question of sulphur content in oil, and wished Conference to believe that in the oil industry there was more "Esso Blue than SO_2"! Mr. Newton concluded by referring to the dangerous use of oil stoves in houses in multiple occupation.

F. L. Waring (Coalite and Chemical Products) said that during most of the session he had felt that he was listening to the obituary of the open fire and, at times, even the obituary of the domestic section of the solid fuel industry. He thanked Mr. Wilkinson for so effectively redressing the balance although Mr. Birtwisle tried to give an addendum to the obituary. Given complete freedom of choice, he was confident that the open fire would remain the mainstay of domestic heating in this country for many years to come. The householder's choice would not be limited by arbitrary restrictions and confused by exaggerated efficiency claims when room heaters or closed stoves were compared with improved open fires.

There was now no doubt that the White Paper last December was a national disaster so far as the effect on clean air progress was concerned. The figures forecast for the future were out of date within weeks of publication and this had been amply confirmed by Mr. Wilkinson. Sir Henry had told the Conference that stocks of gas coke currently exceeded two million tons, more than 600,000 tons of which were of domestic open fire quality. It always had been and would continue to be the objective of the premium fuel interests to make available a fuel which would permit householders either within or outside clean air zones to preserve the benefits of the open fire, which he thought the majority preferred to do. By the early days of 1965 the output of "Coalite" would have increased by 42-45 per cent compared with the end of 1963 and by 110 per cent by the winter months of 1966/67. He was authorized by "Rexco" to say that their expansion would be no less substantial. The combined tonnages of "Coalite" and "Rexco" quoted in the White Paper for the year 1970 would have been achieved by the beginning of 1966 and exceeded by about 30 per cent during the early days of 1967. That, and the information given by Mr. Wilkinson, was the measure of the efforts that were being made by the manufacturers of reactive solid smokeless fuels to make clean air in this country a reality without irksome restrictions. Other plans for further expansion would be dependent on what transpired during the next year or so, but the forward position was already such that local authorities could proceed with their clean air plans in the full knowledge that adequate supplies of specially reactive smokeless fuel would be available for the open fire.

A. E. Snodgrass (Bury) said that the Minister of Housing and Local Government should indicate immediately to local authorities his intention whether or not to prescribe against the installation of radiant electric fires in smoke control areas as indicated in Circular 46/64. Not to do so could precipitate an administrative boggle concerning future availability of electricity supplies similar to that which surrounded supplies of solid smokeless fuels recently and involve occupiers of dwellings in financial disadvantages. He felt that the Electricity Council's film entitled "The Future is Electric" should become "The Future is Atomic", after hearing Lord Sherfield's address.

R. C. Gordon (South Eastern Electricity Board) said that during the past few days the emphasis at the Conference had inevitably been on the use of solid fuel in smokeless zones. He had, therefore, found it rather refreshing to hear something about the contributions other fuel industries had to make towards the establishment of cleaner air and improved standards of heating comfort. As it was the Ministry's clear intention that householders in smokeless zones should have freedom of choice it was right and proper that, to enable them to exercise this choice, the facts about the various fuels should be made known. Every householder who chose one of the cleaner methods of heating, whether in a smokeless zone or not, was helping to make our towns better places to live in and so far as electricity was concerned he felt that Mr. Melling had done the cause of clean air a great service that morning by disposing of many of the misconceptions which seemed to exist about the availability, reliability and competiveness of electricity for heating in clean air zones. No one fuel industry could solve the air pollution problem alone. Nevertheless individually they each had a vital contribution to make and would make it much more effectively if they sold their respective heating services on their own merits rather than by "knocking" their competitors.

As far as electricity was concerned, the spearhead of the electricity supply industries contribution would be the off-peak unit plan storage heater which, he thought, represented the greatest advance in home heating since the invention of the chimney. Moreover, electric thermal storage heating offered the cleanest solution to the heating problem. The indiscriminate use of portable fires during severe weather to make good the deficiencies of other heating systems embarrassed the supply industry. This, of course, was what had occurred in 1961/62 when arctic weather conditions disrupted the supply and distribution of some other fuels. Those responsible for supplying electricity got the blame for their inability to cope with the demand and they felt rather hurt about it.

Mr. Gordon went on to say that popular demand for electricity was expanding so rapidly that the electricity supply industry was now having to double the supply capacity every eight years or so. This was a gigantic task and one about which it said far too little; and others—especially the Press—said even less. However, if some of Sir Henry Jones's high speed gas, either of the home brewed or foreign variety, leaked into one of the electricity manholes and blew the lid off, what happened? They immediately got banner headlines in the Press stating "Electricity Explosion Causes Power Failure". It was a hard world and you just could not win!

Councillor Mrs. M. Ross (Edinburgh) said she regretted that Mr. Wilkinson had been unable to deal more fully with the production of premium solid fuel in Scotland as they had rather a raw deal as far as these fuels were concerned. She was sure that Scottish delegates would welcome assurances from Mr. Wilkinson as to the availability and acceptance as a first class premium fuel of Rexco produced in Fife from Fife coal—eliminating as it did transport of premium fuels into Scotland. At the same time she welcomed the news of the early erection of National Coal Board plant in Ayrshire for manufacture of Roomheat fuel. She assured the meeting that the Scottish housewife had always demanded a high quality coal and expected the same high quality smokeless fuel. She concluded by assuring the Conference that they in Edinburgh were going ahead with the clean air programme.

Dr. K. Gräfe (City of Hamburg, W. Germany) stated that an extremely cold winter did not necessarily result in an increase of emmission. In the journal *Staub*, volume 23, p. 557 (1963) "Wintertemperaturen, Schwefeldioxid-Immission und -Emission", he had been able o show that the SO_2 concentration ecreased in the City of Hamburg onsiderably from 1958-62, i.e. the annual ean derived from hourly values of ontinuous records altered from 0·33 to ·18 mg SO_2/m^3, but in the cold winter he corresponding increase was not more han 0·04 mg SO_2/m^3. The reason for his low increase might depend on the act there that used to exist different eather conditions in cold winters compared with mild winters, i.e. that the SO_2 emissions vanished more easily into the free atmosphere on clear cold days. Although he agreed that electricity and gas were the best fuels with regard to clean air, he mentioned the German experience with district heating by coke. Sometimes the owners of such plants tried to ignore the amount of sulphur in coke in order to allow a lower chimney-height.

Author's Reply

Sir Henry Jones said that he thought r. Birtwisle hardly did justice to the as industry in saying that they always ad something "around the corner". They ad it here and now—750,000 gas heaters nd 90,000 gas central heating installations ixed last year. Nor did he agree that there as a crisis in clean air. As he had said in is address, the gas industry had ample tocks of solid smokeless fuel and, as r. Wilkinson stated, overall supplies of olid smokeless fuel were also ample. owever, it was true that many people ow preferred to use gas.

He agreed with Mr. Michael Graham that gas room heaters, especially those installed in smoke controlled areas where a grant was payable, should not bear purchase tax. He would make further representations to this effect.

In reply to Councillor Gray he did not accept that there was a shortage of solid smokeless fuel in Solihull. The increased price was due to economic factors, related to the cost of production; and was not just intended to deter people from using it.

A Century of Achievement

by

J. S. Carter, C.B.E.*

The Des Vœux Memorial Lecture, Harrogate Conference

IT was about one hundred years ago that public opinion in Britain began seriously to be alarmed at the growing pollution of the air by acid gases from the steadily developing chemical and metallurgical industries and by the damage these gases were causing. In 1862 a Select Committee of the House of Lords was appointed to inquire "into the injury resulting from noxious vapours evolved in certain manufacturing processes and into the state of the law relating thereto." After taking evidence the Committee made their Report during the same session of Parliament. They found that great injury to vegetation, including trees, hedges, corn, grass and garden produce was caused by various manufacturers, the chief offenders being alkali and copper works. They expressed no opinion on the effects of these vapours on human life or health. They reported that "as unhappily, no means have yet been devised of neutralizing the effects of the vapours evolved during the manufacture of copper consistently with the carrying on of this important branch of industry" they did not recommend that copper works should be made the subject of special legislation. The "vapours" from copper works, usually referred to in contemporary writing as "copper smoke" were the oxides of sulphur evolved during the complicated processes for recovery of copper from copper sulphide ores. With respect to alkali works (the roasting of common salt with sulphuric acid in the first (saltcake) stage of the Leblanc process for alkali manufacture) the Committee felt that means for dealing with the acid gases existed and in due consequence there appeared the first Alkali Act of 1863. This matter is treated in some detail in Appendix V of the 1963 Alkali Report—the centenary report.

So much for acid emissions. There was, however, then and for many years thereafter an almost benumbed public acceptance of not merely dark, but often of frankly black smoke as an unavoidable consequence of industrialization. But for the persistence of an angry and determined handful of reformers, amongst whom I am pleased to record the early chief alkali inspectors, this state of affairs could have gone on indefinitely. In the first part of this paper there is set out the smoke position as it was and the improvements which have occurred. As authorities I have the published reports of my predecessors, the valuable reports on effluvium nuisances made to the Local Government Board over the years 1875 to 1878 by Dr. E. Ballard and the Reports of Government Committees with the record of the evidence submitted to them.

First of all, however, an attempt to outline the general position in the 1870's. Priority is given to Dr. R. Angus Smith, the first chief alkali inspector. "Is it not true that those coming into Widnes, even from very dark and gloomy skies, enter that town with a certain awe and horror and wonder if life can be sustained there. . . . Persons told me that when they went to take up their residence in Newcastle they looked from that

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**Chief Alkali Inspector (now retired), Ministry of Housing and Local Government* great high-level bridge on to the Tyne and cried in a kind of despair at the banishment from the south-west, which if not always sunny, is at least always supplied with clean air" (Alkali Report 1875/6). The Tyne came in for some adverse comment in the Report of the Royal Commission on Noxious Vapours, 1878. "When the Commissioners were on the banks of the Tyne they observed a canopy of black smoke almost everywhere." Nor was the London region sacrosanct as the Royal Commissioners reported: 'From numerous witnesses resident in Blackheath, Greenwich, or the neighbourhood we received serious complaints of the nuisance and intense annoyance caused by the offensive smells which proceed from the works grouped on the banks of the Thames. . . . The offensive and nauseating character of their combined odours was attested beyond dispute . . . by our own observations." The Royal Commissioners also received evidence from the Archbishop of Canterbury on the effect of acid fumes received at Lambeth Palace from the salt-glazing of earthenware nearby. Knives and forks rusted before he could use them and the bindings of books in his library disintegrated. His Grace, as did others, drew attention also to the "atrocious smells" from a nearby candle factory and the adjoining "manure wharves". The Royal Commissioners confirmed this and with appreciable tact described it as the "peculiar odour which we perceive on travelling by the South-Western Railway between Vauxhall and Waterloo". Nor did the south-west, eulogized for its clean air by my predecessor, escape for the Royal Commission reported: "A deputation from a public meeting held at Plymouth laid evidence before us as to the nuisance to which residents within a radius of a mile from Plymouth are exposed." Anyone still hankering after a return to the good old days should be completely cured by reading that part of the Plymouth evidence concerning what could euphemistically be termed as background odours. The particular facet concerns "the town dung hill" containing some thousands of tons of "the sweepings and emptyings of everything that is vile" and with "pigs nuzzling up and devouring tit-bits". This is inserted not for the purpose of being evocative of Rabelais, but so that we can be properly appreciative of what sanitary engineers and public health officers have done for us in the meantime.

As to how local authorities and industry viewed the unhappy stalemate concerning black smoke is well shown by that part of the evidence heard by the Royal Commission concerning salt works. The Northwich local authority summed up the result of their many prosecutions as "Heavy fines, and no improvement as regards the quantity of smoke emitted". The spokesman for the salt industry when asked what measures he was taking to reduce black smoke replied "None whatever. I have caved in, and the local authority must fine me as long as they can; and if they fine me to too great an extent, I shall have to shut up. That will be the case with all of us". The attitude of many industrialists was given to the Royal Commissioners by Mr. H. H. Vivian, M.P., a South Wales industrialist. "You cannot have manufactures carried out without suffering these disabilities: half to two thirds of your incomes is derived from manufacturing industry and you must take the rough with the smooth".

There is a timelessness about the nuisance potential of the Thames-side cement works. When the Royal Commission investigated and when production was about one-tenth of what it is today, the trouble was not dust (this came later with the rotary kiln) but smoke and fume. The Royal Commission reported that emissions seriously impeded the navigation of the Thames and that they had received a memorial to this effect by upwards of 130 London Trinity pilots and upwards of 50 steamship masters trading to the port of London. One skipper testified that the smoke crossed the river in such clouds that he could not see the bowsprit end of his ship. Dr. Ballard devotes considerable space to these cement works and their emissions and states that as a result of legal proceedings several were then working under an injunction.

The bulk of the Report of the Royal Commission deals, however, with the chemical, metallurgical and general industrial emissions in the industrial North and in South Wales. The problem here was essentially that of the broad belt of devastated land rendered useless for farming around these works. This aspect is considered in the second part of this paper.

GENERAL INDUSTRIAL SMOKE

The Report of the Departmental Committee on Smoke and Noxious Vapours Abatement set up in 1920 under the chairmanship of Lord Newton contains the sentences "But perhaps the chief factor in the failure to deal with the smoke evil has been the inaction of the Central Authority. No Government has, for many years, taken any action with the exception of appointing committees, whose labours have led to little or no result". This seems to me somewhat unfair to the Central Authority, for in matters such as this Governments can advance no further than public opinion is willing to follow them and it needed the London smog disaster of 1952 to alarm the general public sufficiently for the Clean Air Act, 1956, to reach the statute book. Yet even when the Newton Committee was reporting and when conditions were accepted which would not now be tolerated, there was already major progress to record in the industrial field as the following extracts from my predecessors' published reports show.

"Complaints . . . against the emission of black smoke are numerous, but too intermittent and desultory to bring about much diminution of the evil. . . . It is a curable evil and therefore ought to be cured. In order to purge the air of our manufacturing districts of its black soot, to remove the pall of smoke which shuts out the sunlight and enfeebles both animal and vegetable life, pressure is needed from outside: a determination on the part of the public that the evil shall cease" (1885).

He was in gloomier mood the next year. "It is possible by the exercise of care in the construction of furnaces, and skill on the part of stokers to prevent or very greatly to diminish the emission of black smoke in almost all cases . . . yet the evil continues and the law is not enforced, owing one must say to apathy on the part of the public and a consequent want of persistent effort on the part of the manufacturers. The occurrence of black smoke is so universal in the manufacturing districts that both the public and those who administer the law look on it as an institution too firmly established to be safely attacked. A case occurring in a northern county came lately under my knowledge, where the chimneys of a single factory threw out dense black smoke in such enormous volumes as completely to darken the sky and shroud a portion of the landscape in gloom. Some of those living in the neighbourhood made formal complaint but no redress was obtained. . . . London has the character of being still a smoky city, and so it is, but no smoke is seen there comparable in blackness with that which pervades many towns in Lancashire and Yorkshire . . . in this respect the palm must be given to the chimneys of cotton mills and some iron works" (1886).

Yet in the same report is printed a letter from the chief engineer of the Manchester Steam Users' Association in blunt, north-country speech and the following extract is indeed worth quoting. "Smoke has been shown to be a curable evil . . . over and over again but nothing or next to nothing has been done to bring it to an end, and in my opinion nothing will be done until the prevention of smoke be made compulsory by Act of Parliament and the Act vigorously and judiciously worked. . . . I do not consider that it would be any hardship whatever to render it compulsory that all boiler owners should prevent smoke. . . . If a firm and explicit Act were passed rendering it compulsory to prevent smoke no difficulty would be found in complying with it, and the wonder would then be why the nuisance had been so long endured".

This letter would appear to have encouraged my predecessor for next year he wrote much more forthrightly "In my last two annual reports I drew attention to this subject. I brought forth abundant testimony from engineers and others in support of my assertion that the production of black smoke could be prevented. . . . It cannot be doubted that if a competent authority were during three years, to enforce the observance of the laws prohibiting the emission of black smoke, the difficulties at first experienced would vanish and a material benefit would be experienced alike by the coal user and the public" (1887).

Public opinion was by now aroused and in the following year there appears this comment on black coal smoke "A feeling on the part of the public is apparently on the increase, that the evils arising from this source are great and should be diminished. This has been shown much in Manchester, Bolton and some of the principal smoke producing districts. The mortality in Manchester has lately been on the increase and people have not unnaturally considered that the dark panoply of smoke under and in which they live contributes largely to the evil. A voluminous correspondence has been carried on in the newspapers concerning it". (1888).

Later comments are much more cheerful, the nadir was passed. "The efforts made to prevent or diminish the emission of black smoke from factory chimneys have been well continued during the past year. It is now becoming more fully acknowledged on the magistrate's bench that the evil is to a large extent preventable; manufacturers have therefore been pressed to improve their systems of coal burning, so as to inflict less evil on their neighbours in this respect. . . . An influential committee has been formed in Manchester for testing smoke preventing appliances". (1889).

Finally the report for 1890 records real progress: "In my report last year, I referred to an organization started originally among some manufacturers and others in Lancashire, to ascertain by direct experiment what results were obtained in actual practice by the use of the best smoke-preventing appliances now offered. The movement has made great progress, and a public meeting, convened by the Lord Mayor, was held in its support at the Mansion House, London. One convened by the Lord Provost of Glasgow was also held in the Town Hall of that city, and similar meetings convened by the Mayors of their respective towns have been held in the Town Halls of Birmingham, Leeds, Newcastle and Sheffield, so that the movement may be considered a truly national one". Public opinion was at last aroused and the series of legal and technical measures leading in due course to the industrial provisions of the Clean Air Act, 1956, became inevitable.

By 1921 the Newton Committee could report: "The evidence shows that under normal conditions, and with careful stoking, either mechanical or by hand, little or no smoke need be produced by boiler furnaces, and that in many cases it would be quite practicable without undue expenditure, very largely to reduce the amount at present emitted". By 1921 progress in industrial smoke abatement was indeed such that it had become apparent that the earlier, excessive, black smoke emission had been masking an appreciable emission of grit and dust. The Newton Report states: "certain witnesses have stated in evidence that it is not practicable . . . to avoid the emission of grit". The really great advance in the past quarter of a century has been in the field of grit and dust arrestment.

The arrestment of fine dusts and

especially of metallic fume was not so long ago an intractable problem. The usual method was the application of long flues. Some of these mentioned in the early reports of my predecessors extended a mile or more up hillsides using any cottage in the way as settling chambers. The maximum length was that at a lead works in Wales recorded in the Alkali Report for 1885, of three miles where in spite of this "yet a considerable amount of metallic fume passes from the top of the chimney". Yet the first indications of a solution were to hand for the same report mentions the experiments of Prof. Oliver Lodge, showing "that the passage of a stream of high tension electricity into the fume at once causes it to agglomerate and to deposit like flakes of snow", and states that the method will soon be applied to fumes from lead smelting.

The report for 1886 refers to these trials, the first recorded industrial application of electrical precipitation:

"Last year I drew attention to the experiments made by Prof. Oliver J. Lodge, D.SC., on the deposition of dust by the aid of electric currents, and expressed a hope that the principles might be applied to the retention of solid matter thrown off as dust and fume in many manufacturing operations. Since then experiments on the large scale have been carried out by Messrs. Walker, Parker & Co., at their lead works in Flintshire, with a view to separate more fully the lead fume from the air passing along their flues and escaping from the chimney. A large Wimshurst induction machine, with four glass discs of 5 ft. diameter, was erected, and the currents of electricity carried from it to two wire gratings inserted a few feet apart in the main flue, the gratings being the size of the sectional area of the flue. It was hoped that the electricity in traversing the space between the gratings would cause a deposition of the dust or fume. This result has not, however, yet been attained, but we may hope that a continued study of the conditions of the problem will reveal the causes of failure, and that in due time they may be surmounted."

The works were at Bagillt and the source of power a one horse power steam engine. The installation failed mainly due to the primitive method of producing high tension electricity.

Little more was heard of the industrial application of electrical precipitation until the 1914-1918 war when it was applied to blast furnace gas by the Skinningrove Iron Co. and to non-ferrous metal fume by Vivian and Sons, Swansea. The years following that war saw its application to a great number of dust and fume emissions. Of particular interest here is the first British application to boiler flue gases at Willesden Power Station in 1929. There were major and still growing applications after the 1939-1945 war. It is a basic and incontrovertible truth that but for the electrical precipitator, efficiently to de-dust the great volumes of flue gases involved, the present programme of electrical power production, perhaps the most important arch in the structure of our national clean air policy, involving as it does massive coal-burning power stations of 2,000 MW, would be impossible. Such stations will each consume four to five million tons of coal yearly, and when on full load at the rate of about 20,000 tons daily. As a matter of interest in 1903, the first year for which figures are available, the total national usage of coal for the production of electricity was but three million tons. At the present time about one-third of the coal raised here is burned at power stations and the amount is expected soon to be about one-half. This is in addition to production of electric power from oil and the nuclear power programme. The modern 2,000 MW fuel-burning power station, virtually smokeless, fitted with high duty electrical dust arrestment plant and with waste gases discharged via a 650 ft. chimney is indeed a considerable achievement in the field of direct and indirect reduction of smoke and grit emission. As a matter of interest, the total present cost of meeting clean air requirements at a coal-burning 2,000 MW power station is about £3,500,000.

Also a notable achievement in its way is the publication "Clean Air Act, 1956; Memorandum on Chimney Heights" issued in 1963 by the Ministry of Housing and Local Government. This is without doubt the most straightforward and helpful of all publications with similar aim whether issued by government or scientific or industrial organisations. It has clearly cut a Gordian knot and there should now be uniformity in determining the height of industrial chimneys so as to conform with the requirements of the Clean Air Act, 1956.

Reference was made earlier to the importance of production of electricity as a major factor in the attainment of our national clean air aims. Another important factor, and particularly in the domestic field, is town's gas. Major increase in such gas production is clearly necessary and it is comforting to appreciate that as a result of the recent technical breakthroughs concerning the reforming of hydrocarbons this increased production will not be accompanied by deterioration of conditions at gas-works. The new techniques are smokeless and should carry in their wake the disappearance of that music hall and seaside concert party jest, the local gas works smell.

SPECIAL INDUSTRIAL SMOKES

The most tractable, or perhaps more accurately, the least intractable of industrial dark smoke problems was, of course, that of steam raising. Certain other smoke emissions presented major difficulties, but most have either been solved or are on the way to being solved. Possibly the only serious remaining unsolved problems concern the production of blue engineering bricks and production of lime in coal-fired shaft kilns. Although the emissions from these are serious and in some cases have to be seen to be believed, the operations are largely localized and the total coal involved is only the equivalent of a 300 MW power station. Progress in dealing successfully with some special emissions is given below. A notable omission is that of smoke from various heating and re-heating processes in the iron and steel industry. At the time of the Newton Report (1921) it was firmly believed that for the production of many grades a smoky atmosphere was essential. How this was dealt with is one of the success stories of the past quarter of a century, but it is felt that this would more fittingly be dealt with by representatives from one of the great steel towns as a separate paper on some future occasion.

Pottery

At one time the whole of our pottery came from the traditional, coal-fired, bottle oven once such a striking feature of the Potteries landscape, and which, not even by strict adherence to a code of practice (which adherence it seldom received) could be fired without black smoke. These bottle ovens have been steadily eliminated by kilns using smokeless methods of firing. Before the 1939-1945 war there were over 2,000 coal-fired, operable bottle kilns in the Stoke-on-Trent area. By 1958 there were about 300, and by 1961 about 100. The total is now around 20. There is similar progress to report elsewhere in the other and smaller centres of production. Thus the dozen or so bottle kilns in the Poole area have ceased to operate. Almost all the one-time smoke from the manufacture of pottery has thus disappeared.

In view of the enormous improvement which has occurred it is salutary to refer to Dr. Ballard writing in 1878. "Effluvium nuisance occasioned by ordinary pottery making arises from the smoke evolved from the chimneys. These are almost invariably low, being in fact the top openings of the hovels in which the ovens are placed. In the pottery district of

North Staffordshire such chimneys may at any time be seen vomiting forth black smoke, which not being much heated and not passing away with any remarkable velocity, does not rise high into the air, but quickly falls, filling the streets and roads to such an extent as sometimes to impede vision beyond a distance of a few yards. . . . It is impossible to say to what extent this smoke which pervades the pottery towns, more or less at all times, and especially in some conditions of the weather, affects public health. Certainly it is not conducive to mental exhilaration, and inasmuch as it fouls the skin and clothing, and sometimes compels householders to close the windows of their houses to keep it out, must be on those accounts alone unfavourable to public health, especially among children and among classes of persons who are not much given to ablution. Such a smoky atmosphere as prevails habitually in some of the pottery towns, may not demonstrably shorten life, and diseases may not be distinctly traceable to its operations, yet it is impossible to doubt that it is injurious in at any rate an indirect manner by favouring the operation of other more obvious causes of disease."

Salt

Salt has for centuries been and indeed still is produced by the evaporation of brines. A century ago and for many years thereafter it was entirely produced in open pans heated by hand-operated coal-fired furnaces and as the Report of the Royal Commission of 1878 states: "during the process black smoke escapes in dense volumes". This was confirmed by Dr. Ballard who wrote that the smoke "proceeds in dense black volumes from the low chimneys obscuring light and vision . . . so that it is impossible to see any distance beyond the works". At that time and with a national production of about two million tons yearly there were over 1,000 such pans in the Winsford-Northwich area of Cheshire alone. There are now but 60 open pans operating in the whole of England and Wales and with but two, which make a special grade of salt, hand-fired. The remainder are mechanically fired and with smoke emission down to the minimum. Current yearly make of salt by the open pan route is 100,000 to 150,000 tons, with about one million tons by the virtually smokeless vacuum evaporation route and with over four million tons used directly as purified brine in the heavy chemical industry without actual separation of salt. My predecessor wrote in 1881: "one of the evil things sent out from salt works is black coal smoke . . . many attempts have been made to slay the monster but without success". There is thus now one monster the less.

Coke Ovens

Some 23 to 26 million tons of coal are carbonized yearly in coke ovens in England and Wales. Coke ovens, their mode of operation, their emissions and the report of the working party of the industry and the alkali inspectorate on the treatment of these emissions were discussed at moderate length in the 1960 Alkali Report and it is freely admitted that coke ovens present a formidable problem if emissions are to be reduced to the amounts now felt to be necessary by local public opinion. The crux of the matter is the intermittent nature of the operations. Could a continuous process be devised ninety per cent of the present difficulties would disappear. As it is there is a long and uphill task before us. Yet we are now at a stage which at one time would have been considered as a more than satisfactory solution and it will not be amiss to look back and realize just how bad things once were. The Royal Commission of 1878 were particularly appalled by the seriousness and extent of the emissions from the then universal beehive ovens. It was admitted in evidence by the producers that one-third by weight of the coal used was lost in the form of a thick, black, tarry smoke discharged at a height of from 10 to 15 ft. Mr.

Lowthian Bell, M.P., himself a major producer, admitted that "The effect of the vapours emitted by coke ovens on vegetation is terrible". Dr. Ballard is in his best form on this facet. "Coking is a very great nuisance on account of the constant issue of large volumes of black smoke. Issuing at low level, the fume sweeps along with a wind close to the surface of the earth and produces a sooty and acidic condition of the atmosphere. . . which is distressing and suffocating to strangers, and the unwholesomeness of which, to persons habitually exposed to it, it would be an insult to common sense to question. . . in addition, an habitual disregard of wholesome ablution is sure to grow up out of the despair generated by unsuccessful attempts to maintain even an approach to personal or domestic cleanliness under such circumstances."

The Royal Commission recommended that coke ovens be brought under the Alkali Act, but this was one of the few of their recommendations which was not accepted. Coke ovens eventually came under the Act in 1958. Progress towards current standards really began when the first by-product coke ovens were built at Crook, Co. Durham, in 1882. The last beehive battery, at Whinfield, Co. Durham, ceased operating in 1958.

CHEMICAL AND ALLIED INDUSTRIES

Although the first Alkali Act dates from 1863 and its centenary was properly, and, I believe deservedly, celebrated last year, a more important year, in that it was one when crucial and far-reaching decisions were made, was 1878. The Alkali Act of 1863 concerned only the first (saltcake) stage of the classical Leblanc process for the production of alkali. It was somewhat extended by the Act of 1874 giving powers of control over a few "noxious or offensive gases" from alkali works. The national position was, however, again most unsatisfactory. Since the passing of the first Act production of alkali had increased fourfold and there had been a similar increase in those industries also sending out destructive or offensive emissions not subject to inspection. Complaint of damage was once again widespread and justified. The Royal Commission on Noxious Vapours was therefore set up in 1876 under the chairmanship of Lord Aberdare "to inquire into the working and management of works and manufactories from which sulphurous acid, sulphuretted hydrogen, and ammoniacal or other vapours are given off, to ascertain the effect produced thereby on animal and vegetable life, and to report on the means to be adopted for the prevention of injury thereto arising from the exhalations of such acids, vapours and gases". The Commission, which reported in 1878, went about its task with Victorian thoroughness, visiting Widnes, Runcorn, St. Helens, Northwich, Tyneside, Swansea and "the banks of the Thames below the metropolis". They inspected alkali, cement, chemical manure, coke, copper, glass, lead, nickel, pottery and salt works. They received evidence in London, Liverpool, Tynemouth, Newcastle-upon-Tyne and Swansea from manufacturers, landowners, farmers, clergymen, occupiers of lands and gardens, land agents, scientific witnesses, medical men and local officers and from the alkali inspectors. The record of evidence and the Report reveal a devastation and damage in the vicinity of chemical and metallurgical works, a general industrial smoke pall and an assortment of miscellaneous stenches which are almost impossible of comprehension and certainly of acceptance to-day.

As to the contribution of acid gases from the chemical industry to the devastation, the Royal Commission confirmed that damage to vegetation, crops and cattle in the vicinity of the works and in some cases at a considerable distance, had occurred in the past and in varying degrees was still occurring. Their comments, always forthright, were particularly so on the state of some of the works visited where ". . . the walls were cracked, the towers out of perpendicular, the joints of pipes leaked, the furnace walls emitted gases and the general appearance of the works betokened an insufficiency of means to carry on the works efficiently." There had been some dispute as to whether the alkali inspectors had power to deal with such deficiencies. The Commission recommended that this doubt be removed and control over such matters has since been an integral part of the responsibilities of the alkali inspectorate.

The Commission also confirmed that much public irritation and some of the evil effects complained of were due to sulphuretted hydrogen from alkali waste heaps and which was "capable of being conveyed by a gentle wind fully eight or nine miles." Alkali waste also known as tank waste, a mixture of essentially calcium carbonate and calcium sulphide, was an unavoidable side product of the Leblanc alkali process. For each ton of soda made there was need to dump nearly two tons of this waste and soon vast heaps accumulated. In Widnes the evil-smelling mud was known as "galligu" an onomatopoeic term to indicate its slushy consistency and general nauseous nature. Under the action of rain offensive liquors seeped from the mounds into streams flowing alongside and the discharge of waste acid into these streams gave rise to serious and at times dangerous liberation of sulphuretted hydrogen. Until there was a demand for chlorine, usually for the production of bleaching powder, most of the hydrochloric acid compulsorily scrubbed out of the waste gases at alkali works was unwanted and was discharged into these same local brooks and streams. Hence the seriousness of the matter.

As an illustration of conditions that are now happily gone for ever Dr. Ballard is again quoted. "What occasions the greatest nuisance is the admixture of waste acid from the works with the tank waste liquor in pools, ponds or brooks. Under ordinary atmospheric influences the decomposition of the liquor is slow and gradual, and the evolution of sulphuretted hydrogen correspondingly gentle. But the mixture of acid directly with the liquor causes an abundant and rapid evolution of this gas sufficient to create one of the most intolerable of nuisances. One of the best illustrations of this last source of nuisance that I met with was at Church, a little village on a tidal stream called the Don, which receives abundance of liquor in its course, but the banks of which are formed of waste which is washed and thus made to present a newly exposed surface at each tide. Large quantities of hydrochloric acid are discharged below the village, and when the tide rises it brings up this acid with it. I never had the misfortune of such an exposure to sulphuretted hydrogen as on crossing the bridge over the river close to St. Bede's Church; it was sickening, and the nuisance strongly pervades the little village".

The Commission recommended that control over the disposal of such waste should be entrusted to the alkali inspectorate.

On the matter of "copper smoke" the Royal Commission came to the same conclusion as the Lords Committee of 1862, that the injurious effects were at least as great as those of the acid gases from the alkali works. This was particularly true on Tyneside and St. Helens, where the greater part of the damage was attributed to copper smoke, whilst "the bare and blasted aspect of the country round the copper works of Swansea leaves no doubt as to its destructive effects". As with the Lords Committee they could see no means for dealing with the nuisance, but they recommended copper works be put under the Alkali Act so that they could regularly be visited by inspectors in the hope of an eventual solution being found.

The Royal Commission was forthright on the nuisance caused by chemical manure processes, tar distilleries, by-product ammonia works, on various facets of dark smoke production and on cement making and recommended that these also be entrusted to the care of the alkali inspectorate.

On the health aspect the Commissioners were much less forthright and came to no definite conclusion stating "the evidence given as to the alleged high death rate in certain parts of Liverpool and in towns on the bank of the Tyne, is encountered in the case of Widnes and Swansea by equally specific evidence as to the low death rates and generally healthy character of the population of these towns". They felt, however, that they could not disregard the opinion expressed by all the medical witnesses that some injurious consequences were due to these gases and that public health would be benefited by their diminution.

The general tendency of evidence heard was that all these works should be subject to regular inspection either by the central or the local authority. On the whole industry, which was somewhat frightened and rather bewildered by the damage it was causing, was in agreement, but favoured powers being placed in the hands of the central authority. Interestingly enough the only witnesses who, advocating the principle of inspection, were on the whole in favour of local as opposed to central inspection were civil servants, being the witnesses from the Local Government Board, the forerunner of the present Ministry of Housing and Local Government, and under whose aegis the alkali inspectorate were then, as now, operating. After reviewing all the evidence the Royal Commission recommended that the task be entrusted to the central authority and that the Alkali Act be extended and amended according to certain recommendations. Most of these were accepted but the administrative and political climate was such that the recommendations on copper smoke and on the black smoke processes were not acceptable. Copper smoke had to wait until 1906 for registration under the heading of smelting works and the others to 1958 before inclusion in the Alkali Act.

The eventual result of the Royal Commission was the Alkali etc. Works Regulation Act, 1881, the first of the Alkali Acts attempting comprehensively to deal with a growing chemical industry. The Act of 1881 was the beginning of a period of achievement, possible in no other country, in that there could be a truly national policy in these matters. The central authority and the alkali inspectorate were fortunate in that the first chief inspector, Dr. R. Angus Smith, was still in post to ensure that the new venture was started with the proper mixture of understanding, occasional forbearance and necessary firmness when called for.

It would be tedious to go into details as to how these various problems were dealt with. For such as are interested, the practice was begun in 1960 of selecting some of the older registered processes for historical and technical review in the published alkali reports. They are as follows, the year of the report being given: alkali (1963); alkali waste (1960); cement (1960); chemical manure (1961); chlorine (1961); nitric acid (1963); salt (1962); smelting (1962); sulphate of ammonia (1961); zinc (1962). For purposes of record, mainly to keep pace with an expanding chemical industry there were further Acts in 1892 and 1906, the scope of the latter being extended by Orders in 1928, 1935, 1939, 1950, 1958, 1961 and 1963.

The Orders of 1928 to 1950 inclusive were merely expansions of the scope of the Act and along conventional lines. The 1958 Order was that which greatly expanded the scope so as to cover the "smoke" processes as recommended initially by the Committee on Air Pollution (Cmd. 9322) under the chairmanship of Sir Hugh Beaver and concerning which I had the privilege of addressing this Conference in 1962. The 1961 Order was a highly specialized one dealing with toxic metals. The 1963 Order was in the main a return to the conventional chemical engineering field of the alkali inspectorate. It also effected the first "descheduling" whereby control over emissions from certain processes was returned to the care of local authorities. Such return was also one of the recommendations of the Beaver Committee.

Over the years the alkali inspectorate and the industries in their charge have had their set-backs and their failures, yet they have achieved much. Often we have learned our lessons the hard way and have our scars. Yet we have learned not to make the same mistakes twice. Perhaps the greatest and indeed crucial achievement was in the immediate post-war years when we had to face up to the new and urgent problems presented by the massive post-war expansion of the heavy chemical and allied industries, and of the developing petroleum industry. Lessons already learned the hard way, but relating to a much smaller scale of operation undoubtedly came in useful, but the late 1940's and early 1950's called for rapid re-orientation of thinking and urgent reappraisal of standards. There were inevitably mistakes of detail, but the broad decisions were sound. The farmlands come up to the boundary fence. There are occasional complaints, often justified, but neither litigation nor bitterness, nor need for a Royal Commission.

It was the success attained here that gave confidence to cope with the 1958 Order processes, power generation, coal carbonization, iron and steel, brickworks and the like. The tasks were often greater as regards scale of operations, but we had had our gruelling experience a few years earlier and when we had to jettison some of our cherished pre-war concepts. The 1958 Order processes brought with them the need for an equally important re-orientation of thinking and of re-appraisal of values in the field of public relations. Before 1958 the alkali inspectorate were perhaps inevitably a somewhat esoteric body, but with the acceptance of clean air legislation on a national scale they are now permanently out of any ivory tower. One of the most pleasing features is the increasing and cordial liaison between the alkali inspectorate and the officers of local authorities. It is an instruction to inspectors that routine calls on local authorities to review matters of mutual concern are an integral part of their duties. I am also pleased to record that inspectors are increasingly invited to give talks to local authority and industrial groups and to scientific and technical bodies on problems of industrial emissions and their solutions. When I spoke to this Conference in 1962 it was the first time a chief alkali inspector had done so. That was one barrier flattened and I trust that talk will be the forerunner of many.

It is not proposed here to discuss our present problems. This is essentially a historical review. Our current problems are considered in each successive alkali report, and in any case my successor will be available at future Conferences to deal with such matters if need be—as I hope it will.

Before concluding, a brief reference to my one ewe lamb, the published annual reports of the chief alkali inspector. It is a statutory requirement that he "on or before the first day of March in every year make a report in writing. . . of the proceedings of himself and of the other inspectors . . . and a copy of such report shall be laid before both Houses of Parliament". Some of my predecessors may have regarded this as a tedious task, but the first two chief inspectors clearly relished it and I have certainly done so. My major regret is that modern restrictions as to space prevent me from moralizing at the lengths permitted in the Victorian age. I have tried in these published reports to give in as straightforward and as homely a fashion as the technicalities allow an account of the state of each industry as concerns its size, its problems, how they are being tackled and of our successes and of our failures, neither stressing the one nor concealing the other. It is of prime importance that there should be an honest and a continuing record.

They contain as fair and as honest and as understandable an account of each year's activities as I can make them to be. I attach real importance to the various recorded averages of tests made on final escapes to air and have steadily increased the list since I became chief inspector. The recorded figures are actual performances, not mere standards agreed by a committee of savants in the pious hope that sometime industry will adhere to them and somebody will go round to check that it does.

This paper is given in no mood of complacency. No one can be better informed than the chief alkali inspector of the remaining pockets of technical difficulty, of the few—the very few—firms who are less co-operative than they might be, of the new tasks facing us or of the still dimly seen problems of the future. Yet by no system of assessment, however strict the scrutiny, can the progress be regarded as other than massive. As a national achievement it stands second to none.

Discussion

Dr. J. A. Cooper (Imperial Chemical Industries, Billingham) said he was very glad to have the opportunity of opening the discussion and had listened with very great interest to Dr. Carter's remarks in which he had made clear the problem the Society now had to face. It was no longer one of gross pollution from hundreds of low level chimneys where fuel was burnt inefficiently but instead the emission of industrial gases cleaned to a very high degree of purity, but still, because of their magnitude, capable of exerting an adverse effect on the atmosphere. I.C.I. Billingham were very much in the centre of this current and very proper concern with atmospheric pollution. Having spent something in the order of £1½ million at Billingham since the war in endeavouring to reduce pollution they would be very willing to spend a great deal more money provided adequate technical solutions could be found.

On Tees-side the problem was the concentration of vast industrial concerns, *e.g.* the steel industry, the chemical industry at Billingham and Wilton and elsewhere on Tees-side, and a power station. In most cases the best practical methods were used to remove dust, *i.e.* cyclones and electrostatic precipitators and in the case of most of the chemical plant high efficiency washers. Nevertheless small quantities of fine micron dust did escape through these devices, and in the case of the fuel burning industries it was not normally considered practicable, either by the C.E.G.B. or by anybody else, to remove SO_2. One of the disadvantages of attempting to remove SO_2 by a wet process was of course the production of a wet low level plume which could be more disagreeable in the immediate neighbourhood of the process than the original plume which had buoyancy to aid its dispersal. The current practice was to reduce the ground level concentration of SO_2 by having very tall chimneys.

When the wind was from the north-east and near saturated under temperature inversion conditions, an atmospheric ceiling was formed and plumes from the district's factories, rolled towards the residential areas, forming a mist or fog which was stabilized by finely attenuated dust. This and the industrial pall on Tees-side from its various industries could be seen fairly clearly from the high ground near Middlesbrough: under adverse conditions a fog was formed and under less severe conditions a haze, tending to spoil the amenities, particularly during fine weather. Unidentified industrial smells sometimes associated with the fogs caused complaint in the district and presented a very difficult problem because of the very minute quantities present of any chemical causing smell. I.C.I. now maintained a small mobile laboratory and was only too willing to send this around in an endeavour to trace any smells that were reported or any complaints that were made in this connection. It was usually very difficult if not impossible to identify positively any smells with a particular factory, although of course in the minds of the general public any smell was a chemical smell. Two bad smells, one a cat smell and the other a fish smell, had caused numerous complaints. He was very glad to say that as a result of the steps taken by the Company these had been almost 100 per cent cleared up. Where it was clear that a particular smell was associated with a factory, that was to say ammonia at Billingham, a determined attack on the sources of emission was made; leaks for example could be suppressed by using welded pipes instead of flanged pipes, ammonia in various exhaust gases scrubbed out with water and processes modified to prevent ammonia emission and so on.

There was no room for complacency on Tees-side, and all factories there as well as the local authorities concerned with pollution from domestic chimneys, did their best to reduce pollution. The subject of effluents was considered extremely important at I.C.I. There are frequent meetings with the senior managers who review methods for tackling these problems and discuss progress with the help of a specialist staff and a director responsible for effluent problems. However, the outstanding difficulty of fog or haze in a heavily industrialized area under adverse weather conditions remained.

Dr. E. C. Halliday (South Africa) said that he was glad to be at the Conference and to speak for one of the countries which was copying England in its attempt at smoke control. Both Australia and South Africa had developed legislation which was largely modelled on the Alkali &c. Act plus the 1956 Clean Air Act. South Africa started thinking about legislation nearly ten years ago and their own Act should be through parliament in 1965. Industries were taking action along the lines mentioned by Dr. Cooper of I.C.I. and he was sure that the good reception in South Africa from industry, even before the passing of legislation, was due to the fact that industries which had come from England and America were willing to take measures right now because of their experience of preventive processes. He was grateful for the reference to the Alkali Inspector and industry facing problems together. Dr. Carter had pointed out what British industrialists certainly knew, and what South Africa had to learn, was that the Inspector was not the man who knew everything about the problem but was the man who worked with the industry to find the answer to it.

Dr. Halliday said he was very grateful for the assistance received from the Alkali Inspectors and from quite a number of health inspectors in towns of England he had visited to gain information, and concluded: "When you are thinking of a hundred years of progress, although you agree you have still got further to go, we from South Africa would like to congratulate you and say we are making use of your experience".

I. C. Fowler (British Iron and Steel Federation) said that the steel industry was unable to look back as far as 100 years when reviewing achievements in the field of air pollution control. Efforts had been made largely this decade and it was to these that he would refer. The British Iron and Steel Federation had recently completed a survey amongst its members, of the capital expenditure involved solely in complying with recent air pollution legislation. Air pollution problems in the steel industry were divided into two—those involving grit, dust and smoke emissions from boilers and steam locomotives etc., which required compliance with the Clean Air Act and those involving technical pollution problems such as sinter strands and steelmaking units which were subject to the provisions of the 1906 Alkali Act. Compliance with the Clean Air Act had, in many instances, gone hand in hand with technological advancement. In efforts to increase fuel efficiency, coal firing had been freqently replaced by electrical or oil firing and similarly steam driven rolling mills, locomotives and cranes were now powered by electrical or diesel equipment. It was clear that in such cases the expenditure involved could not be proportioned to either increased plant efficiency or air pollution control with any real meaning and similar arguments applied to the replacement of coal firing by electrical heating or oil firing or the improvement in rolling mill operation.

The capital expenditure involved in the installation of gas cleaning equipment to meet the requirements of the 1906 Alkali Act was capable of analysis as, with a few calculable exceptions, the complete cost could be debited to air pollution control. For example, blast furnace gas cleaning had been practised by the steel industry for many years and some cleaning plant had been installed on sinter plants before the 1958 Alkali Order had become effective and the cost of these had therefore been left out. In the survey the cost of waste heat boilers on pneumatic steelmaking vessels and open hearth furnaces had, however, been included. These units produced credit in the form of steam for use elsewhere in the works but some form of cooling of the waste gases was nevertheless essential before gas cleaning. Thus, only gas cleaning equipment on sinter plants, steelmaking vessels and deseaming units remained and that alone had cost the steel industry £20 million. The steel industry did not profess to be beyond criticism, far from it, nor was it complacent, but it did submit this expenditure of £20 million as concrete evidence of the industry's efforts to be a "good neighbour".

R. A. Hacking (Richard Thomas and Baldwins Ltd.) congratulated Dr. Carter on his most inspiring narrative of a century of progress in the interests of the whole community. The quickening in tempo during the last six years derived largely from the wise and statesmanlike way in which Dr. Carter had steered the scheduled processes, of which iron and steel was but one example, smoothly but firmly along the right path. Coincident in time with vast technical changes involving new and formidable problems, his task had been made all the more complex and difficult; but he had done it in such a way as to take much of the sting out of the vast largely-unremunerative expenditures incurred, and to give industry a sense of satisfaction with the result.

It was characteristic of the man that on the eve of his retirement his last series of informal meetings with industry had been devoted to clearing up all outstanding problems; and fixing dates for implementation of plans, so that his successor, Mr. F. E. Ireland, took up his task with a clean slate. He wished Dr. and Mrs. Carter a long and happy retirement in the cleaner atmosphere he had done so much to achieve.

Author's Reply

Dr. Carter in reply said that one of the big problems now confronting industry and clean air enforcement officers was indeed, as indicated by Dr. Cooper, that resulting from the concentration of industry, chemical, metallurgical, petroleum, power generation etc., in relatively restricted areas and especially on estuaries. In addition to Tees-side it was developing on Thames-side, Severn-side and Humberside. The task was difficult and remedies costly, but the problem was not intractable. Residents must, however, accustom themselves to a new skyline. Tall chimneys were inevitable. As to the special facet of Tees-side, as both the industries and local authorities concerned were aware, the alkali inspectorate were already treating this as a special area for intensive study. One reason why the chief alkali inspector designate, Mr. Ireland, was not at the conference was that he was paying a preliminary visit to Tees-side this present week to see the problem for himself. He (Dr. Carter) as his last official task away from Whitehall was to call at Billingham in early November to discuss further remedial measures with I.C.I. who were anxious to be as good neighbours as practicable.

He was indeed pleased to see his old friend Dr. Halliday and gratified by his remarks. No country could pay us a higher compliment than to model their clean air legislation on ours.

As to the remarks by Mr. Fowler and Mr. Hacking, the iron and steel industry were indeed facing up to the task of being good neighbours in a most satisfactory manner. He was more than pleased by the way this great industry had set about this massive and costly task. The next two to three years should see it virtually completed.

There were no grounds for complacency anywhere. What had been achieved and was still to be achieved must be maintained, but given a continuance of the present tripartite co-operation—cordial and understanding—between the control and local authorities and industry we shall all of us live to see a far cleaner land than that into which we were born.

Road Vehicle Pollution

Black Smoke—Some Causes and Possible Methods of Control

by

*H. D. Fawell, A.M.I.Mech.E.**

Introduction

THERE is little need to remind this Conference that if life in our cities is to remain tolerable during the motor age, we must constantly be alert to the possible dangers of air pollution in one form or another caused by motor vehicle exhaust. In this country, this source of pollution is only a very small proportion of the total air pollution and present evidence so far seems to suggest that under normal conditions the natural dispersion of toxic exhaust gases is likely to prevent them reaching dangerous concentrations in our cities, but a special Air Pollution Unit established by the Medical Research Council is keeping continuous watch on this aspect of pollution. Elsewhere, and particularly in Los Angeles, California, the position is different and we are closely watching the measures taken there in order to reduce the output of toxic gases by petrol-engined vehicles.

There are two main dangers from motor vehicle exhaust—danger to health which comes mainly from the invisible but toxic fumes contained in the exhaust from petrol-engined vehicles and danger to road users from black smoke emitted by diesel-engined vehicles which jeopardizes road safety by obscuring the driver's view ahead. Despite the potentially greater danger to health from the toxic exhaust of the petrol engine and its ability to emit some smoke when it is in poor condition, in our experience the emission of black smoke by the diesel engine causes most public concern at present —perhaps because it looks and smells more unpleasant. This Paper therefore, deals with the reasons why diesel engines smoke and how best this can be prevented. It also explains the steps taken by the Ministry of Transport to encourage operators of diesel-engined vehicles to prevent smoke by applying good maintenance methods and to show the error of their ways to those operators who do not.

Basic Engine Design Features

Before talking about "black smoke" it is perhaps worth while to consider briefly the differences in construction and operation of the petrol engine and the diesel engine or, as they should more properly be called the spark ignition engine and the compression ignition engine. In the case of the petrol engine, a mixture of air and petrol in vapour or droplet form is drawn into the engine, compressed and ignited by the sparking plug to give the power stroke after which the waste products of combustion are expelled into the atmosphere. The proportions of air and petrol mixture drawn into the engine are decided by the carburettor setting and the quantity by the accelerator position before the mixture is drawn into the cylinder and compressed. Although the compression of the mixture raises its temperature, this is not normally enough to cause it to ignite spontaneously.

The compression ignition engine on the other hand always draws in a full charge of air which is compressed roughly twice as much as in the case of the petrol engine. Liquid fuel in the form of a spray is then injected into the cylinder when the air is fully compressed and the temperature to which the air has risen is sufficient to cause the fuel to ignite and burn—hence the name compression ignition. The power and exhaust strokes follow in the same way as in the petrol engine.

**Ministry of Transport*

The carburettor which meters the petrol/air mixture for the petrol engine is replaced in the compression ignition engine by two separate components—the fuel pump, which meters the fuel and pumps it at high pressure to an injector which controls the introduction of the metered quantity of fuel into its own particular cylinder, there being one injector to each cylinder. The fuel pump must measure out the right amount of fuel required by each cylinder and transfer it at the right moment to the appropriate injector. The injector which is operated by the pressure of the fuel transferred from the pump must open and close at the right times and must convert the liquid fuel into a fine spray and distribute it correctly within the cylinder. Pumps and injectors are precision instruments of high quality and will continue to give satisfactory service for long periods provided they are properly handled and maintained, but like any other man-made contrivance, they are fallible.

From this brief description, you will have appreciated that in the case of the compression ignition engine, the air and fuel are metered separately and a change in the amount of either one can upset the combustion process. Furthermore, anything which alters the temperature of the air when compressed will also have an effect on combustion.

Causes of Smoke in Compression Ignition Engines

Basically, we get smoke when the products of combustion expelled into the atmosphere contain unburnt fuel in one form or another. Occasionally, the smoke is whitish in colour, particularly when starting on cold mornings or before the engine has warmed up to its normal operating temperature. This sort of smoke is really a fog of liquid fuel particles and does not usually persist for very long. Sometimes the smoke is bluish in colour and like white smoke can also upon occasion be associated with cold starting conditions, but frequently it is due to lubricating oil being burnt in the cylinder together with normal fuel. This latter sort of blue smoke which usually indicates a worn engine can occur equally well with either a petrol or a compression ignition engine. For the most part, the smoke is black or grey in colour and it is with this sort of smoke which consists of solid carbon particles that the paper is principally concerned. Generally speaking, smoke occurs when the burning of the fuel is either delayed longer than the designer of the engine intended or the proportions of air and fuel are wrong because there is too little air or too much fuel. Assuming that the engine when new had a clean exhaust the following are some of the possible causes of smoke.

Delayed burning of the fuel

The whole process of injection of fuel may start late because of delay in the timing. This could be due to faulty re-assembly after a previous overhaul or to worn or stretched timing chains, back-lash in the pump drive or wear in the pump coupling. In regard to the matter of timing it should also be mentioned in passing that smoke can sometimes be caused by over-advanced timing. This is likely to arise more particularly in the case of indirect injection engines—that is to say, engines in which the fuel is injected into an ante-chamber connected to the main combustion space. Again, injection may start at the right time but the period of injection may be unduly prolonged for a number of reasons, such as, bad distribution of fuel due to a blocked injector nozzle or incorrectly fitted injector, dribbling of fuel after injection should have ceased because of incorrect seating of the injector needle, damaged or kinked high pressure pipes between the pump and injectors or by such damaged pipes being replaced with pipes of the wrong length or bore. All this is assuming that the original injectors when changed for servicing are replaced by the correct type. Another cause completely dis-related from the fuel injection equipment is loss of compression in the engine itself. This will result in a reduced compression temperature when the fuel is injected and may be due to carboned up or broken piston rings, excessive cylinder wear, valve wear, incorrect valve seating, sticking valves, or incorrect valve clearances.

Wrong proportions of air and fuel

Too little air could be due to nothing more than a choked air filter because of lack of attention—a condition which is particularly likely when the vehicle is working in a dusty atmosphere. It can truly be said that pollution begets pollution. Over a period of time, engines consume vast quantities of air and air filters cannot be expected to remove all the dust particles. In consequence, some of them are drawn further into the engine and can foul the various passages between the air filter and the cylinders and thus further restrict the air flow.

On the other hand on engines having fuel pumps fitted with vacuum type governors fouling of the air passages may in some cases upset the governor speed setting and result in over-fuelling. Incorrect setting of the governor resulting in speeds above the normal maximum can also result in over-fuelling with either mechanical, hydraulic or vacuum type governors. More particularly, over-fuelling can be caused by incorrect setting of the maximum fuel stop on the injection pump or by failure of the excess fuel device to re-set automatically to normal after it has been used to assist starting. This latter is unlikely except where there has been deliberate tampering which is now made illegal by regulation.

Other Factors

Other factors, not connected with the engine, which may have an effect on smoke, are changes in temperature and pressure of the atmospheric air. It is more important that the correct weight of air is drawn into the engine than the correct volume. An engine which has a clean exhaust on a cold day at sea level may very well smoke on a hot day at an altitude of a few thousand feet. Normally there is little significant change within the generally agreed specification of fuel oils intended for use in compression ignition engines but such variations can marginally affect the cleanliness of the exhaust. Another factor which is more usually associated with white or perhaps blue smoke is the temperature of the engine which should preferably be maintained as close as possible to its upper limit. A faulty thermostat which does not allow a cold engine to warm up rapidly may give rise to white smoke.

Methods of Control

In the broadest possible sense, control starts with the initial design and finishes in the Police Court but there are a number of specific forms of control which might be considered individually, starting with those which are of a long term nature and finishing with more immediate methods.

Engine Design

Present day design of compression ignition engines follows a limited number of fairly clearly defined channels. Over the years, as designs have improved, the ability to introduce sensational changes has diminished and today improvements tend to be marginal but that is not to say that the present day designers are complacent. The desire to achieve improved efficiency and in consequence less smoke is as great or perhaps even greater than it ever was and there is increasing collaboration between engine designers and fuel technologists to explore together new techniques and possibilities. Because the fuel is injected into the combustion space in the cylinder the fuel/air mixture—initially at least—is not homogeneous, since the fuel must seek out its air and in consequence a problem which is constantly receiving attention is that of further improving the mixing of the fuel and air. To this end researchers have devised means which enable them to look inside the combustion space—and photograph the whole process of the injection and burning of the fuel. Not so long ago, I was able to look at some strips of colour film from an ultra high speed camera capable of taking some thousands of pictures a second. When these pictures were projected at normal speed, it was possible to follow step by step the injection of the fuel and its distribution within the cylinder, the initiation of burning and the way in which the flame spreads throughout the combustion space while the colour of the flame gave information about the completeness or otherwise of the burning of the fuel. By this and many other means researchers and designers are increasing their knowledge so as to be able to build better engines in the future.

Performance Standards

Standardization of engine performance is another form of control which is receiving consideration both nationally and internationally at the present time. In this country, the British Standards Institution have a Committee which is considering this problem and mention was made at your Conference last year at Scarborough about their activities. One of the factors which this Committee is considering is the establishment of a smoke standard related to power output under specified test conditions. Without such a standard, purchasers of vehicles could be unaware of how close a particular engine might be to the smoke limit when on full power. In this connection, there are many operators who already appreciate the significance of having an engine of sufficient size to be capable of operating with something in hand. There are, however, those who think that they are saving money by sending a boy on a man's errand. A vehicle which is under-powered is constantly thrashed by the driver in an effort to keep his place in the traffic stream, in consequence of which engine wear is accelerated and fuel consumption is adversely affected to an extent that is more than likely to offset any apparent advantage in reduced capital expenditure. In addition, under-powered vehicles besides being a nuisance, may upon occasions constitute a real traffic hazard and this leads inevitably to consideration of whether or not there should be a specified minimum horsepower/weight ratio for commercial vehicles and the countries of Europe are currently considering the desirability of establishing such a standard internationally. In this country the Minister of Transport has already announced the setting up of what is called a "Plating Committee" to work out a scheme by which the maximum permissible gross weight of a vehicle can be determined solely in relation to its design and construction and regardless of whether that weight is less than the statutory maximum for that class of vehicle. The agreed weight would be required to be displayed on a plate on the vehicle and it would be an offence to load the vehicle beyond that weight. In arriving at an agreed weight, it would not be unreasonable to take into account the horsepower of the engine as determined by a recognized standard, even if there was not an official requirement for a minimum horsepower/weight ratio but the establishment of both the horsepower and the plated weight provide the necessary ingredients for such a requirement.

Treatment of Smoke

From time to time suggestions are made for controlling smoke emission by devices not directly connected with the prevention of the formation of smoke but rather concerned with modifying the smoke after it has been formed. These suggestions have included a variety of methods and devices including the use of additives in the fuel intended either to reduce or eliminate the smoke or change its smell, filters for removing the black particles, washers or scrubbers for cleaning the smoke and such means as electric precipitators for collecting the solid particles before they are emitted. Suggestions have also been made for the use of after burners, both catalytic and non-catalytic, which are intended to oxidize some of the unburnt particles before they are emitted into the atmosphere. Devices of all these types and many more are from time to time considered and some have been tested by Warren Spring Laboratory but in their opinion these tests have so far not indicated that the improvements obtained in preventing black smoke represent both a worth while and a practicable contribution and are in no way comparable with the improvement that can be obtained quite simply by good design, proper use and good maintenance.

Indirect Enforcement

Turning to the more short term aspects of control, I mentioned last year at Scarborough that the Department was investigating schemes for intensifying its effort with regard to the checking of goods vehicles. An immediate consequence of this has been the institution of "blitzes" on goods vehicles in quite a considerable number of centres in London and the Provinces about which you will no doubt have read in the daily press. This sort of effort which is dependent to some extent upon the staff available is but a beginning and it is hoped to develop goods vehicle inspection to a point when all goods vehicles will receive regular attention at annual intervals. On the question of staff, I also mentioned last year that we were hoping to recruit more Vehicle Examiners. That recruitment has been successfully completed and further recruitment is now in progress which will enable us to extend our activities still further. These activities while primarily concerned with the mechanical condition of the vehicle will also have regard to the smoke aspect and will supplement the existing smoke checks where the detection and prevention of excessive smoke is the primary object.

Before considering the more direct forms of control by enforcement I would like to mention one other sort of control which cannot be made mandatory but can be applied voluntarily—I mean good driving practice. In some cases drivers can avoid or reduce smoke simply by changing into a lower gear rather than hanging on in top when coming up a hill. Again, on many a smoke check a driver has been observed coming up a hill with his vehicle smoking quite heavily but when he has realized that he is being watched the smoke has stopped which suggests that easing the accelerator just a little and not trying to squeeze the last ounce can sometime have a beneficial effect. I would make a special plea to all drivers to have consideration for their companions on the road and avoid making unnecessary smoke. I am glad to note that the road transport operators organizations have apparently had similar thoughts and are encouraging drivers to become smoke conscious and to tell their own firm and other drivers when vehicles are smoking. Drivers might also be encouraged to change the belief which many hold, that more smoke means more power.

Direct Enforcement

Enforcement by the Ministry of Transport

Coming now to the more direct forms of enforcement, the first are the smoke checks carried out by Ministry of Transport technical staff. These have been carried out on a regular and increasing basis over the past three years and are organized either as national checks or regional checks although the principle for both is the same. In the case of national checks the entire technical staff of the Department's Traffic Areas is employed on nothing but smoke checks throughout the whole country on the same day so as to have the greatest immediate impact. The regional checks are carried out by individual Traffic Areas at dates selected by themselves and with teams of technical staff as available. Since the Department's staff have no powers to stop moving vehicles on the road it is necessary to enlist the services of the Police and in consequence arrangements have to be planned some time ahead. In addition to the Police, a smoke check team usually consists of a Senior Vehicle Examiner in charge and four Vehicle Examiners. One problem is the choice of suitable sites. Preferably one needs a hill on a road carrying fairly heavy commercial traffic with reasonable visibility towards the bottom and the top from a point part way down the hill and a lay-by or other similar provision at or near the top of the hill where vehicles can be stopped and inspected off the road.

Procedures at the check points may vary in detail but in general they follow a more or less common pattern. An observer is stationed at the point part way down the hill where he is in a position to watch vehicles coming up the hill and to signal to Police near the top when he considers a vehicle is smoking excessively and should be stopped. A more detailed inspection is carried out by the vehicle examiners after any such vehicles have been stopped. In the case of national checks a record is kept of all the commercial vehicles with compression ignition engines passing the check point in an up-hill direction in order to determine the proportion of smoking vehicles. At some checks the makes of vehicles are also recorded.

The examiners grade smoke into three broad categories—heavy, medium and light smoke. The vehicle examiners using their technical knowledge and experience assess smoke visually and do not use instruments although Headquarters' staff using instruments have, sometimes, accompanied vehicle examiners at specific checks for the purpose of obtaining information and co-relating subjective and objective measurements of smoke.

Smoke is considered to be heavy when it is so dense that the safety of other road users is affected because of obscuration of vision of overtaking and passing motorists. In such cases the vehicle examiner issues an immediate prohibition which means that thereafter the vehicle is not permitted to carry goods until the defect has been put right to the satisfaction of a vehicle examiner and the prohibition has been removed. In the case of a vehicle carrying a load at the time it may mean that the load has to be transferred to another vehicle before the prohibited vehicle can be moved from the scene of the check. Alternatively, provided time will allow, the operator may arrange for the defect to be put right on the spot with the hope of the prohibition being removed by a vehicle examiner there and then.

Medium smoke is regarded as smoke which is not sufficiently dense to be an immediate danger but is nevertheless excessive and immediately objectionable and likely to become dangerous in the future. Such cases are dealt with by means of what is called a delayed prohibition which at the discretion of the examiner is timed to become effective at some period ahead up to a maximum of 10 days from the time it is issued. As in the case of an immediate prohibition the vehicle must be seen again by a vehicle examiner in order to withdraw the prohibition if the repairs have been satisfactorily carried out within the delay period or to remove it if the delay period has elapsed and the prohibition has come into force but again subject to completion of satisfactory repairs. In the case of a delayed prohibition the vehicle may continue to carry goods within the delay period but not after the prohibition becomes effective.

Light smoke is smoke which though visible is not likely to cause a nuisance but is denser than one would expect from an engine in good condition. In these cases the driver is warned by the vehicle examiner and a letter is sent from the Traffic Area to the owner of the vehicle telling him that the engine is in need of attention and asking him to let the Area Office know what steps he has taken to put the matter right or alternatively saying that a vehicle examiner will call upon him in the near future.

The follow up action by vehicle examiners as a result of the issue of prohibitions or warning letters is considered to be one of the most important aspects of a vehicle smoke check. This brings the vehicle examiner into direct contact with the owner of the vehicle and enables him to inspect other vehicles in the fleet, to discuss maintenance problems and upon occasion to offer advice as to the sort of action which should be taken in order to eliminate smoke. To many operators, fuel injection equipment is still something of a mystery and few have the specialized equipment and technical knowledge to be able to service the equipment themselves. In consequence, we find fuel injection specialists setting up in business all over the country in order to provide servicing facilities for these highly specialized components. Many, but not all of these specialists are linked to the manufacturers of fuel injection equipment and have received intensive training in the way in which their products should be serviced. Even so it is perhaps a disadvantage that these specialists are all too frequently divorced from the commercial vehicle garages and repairers used by operators and have no knowledge of the condition of the engine associated with the equipment they are servicing. Also there is no direct control over them by manufacturers and inevitably standards do vary. Nevertheless to any operator without the specialized equipment and necessary training and skill who is tempted to dabble with fuel injection equipment the only advice I can give is "don't".

In view of what I have said so far it is perhaps not surprising that in many cases an operator who is told that his vehicle is smoking will as a first step blame the fuel injection equipment and arrange to have it changed for service replacements at some quite considerable expense to himself only to find that the vehicle still smokes as badly or perhaps even worse than it did before. In such circumstances, understandably, his attitude is "I have done what I can —what else can I do?" It is at this point that the vehicle examiner can often play an all important role by helping the operator to understand that the fault lies somewhere else and is of such a nature that it would not have caused the smoke in the first instance, if the operator himself had carried out the normal routine maintenance of parts of the engine with which he is familiar. In other cases, where the fault does lie with the fuel injection equipment, helpful advice can be offered about specialist facilities in the operator's area. The Ministry feels that education of this sort is one of the most important features of the campaign against smoke. During their follow up action, vehicle examiners attempt where possible to establish with the operator what the causes of smoke are. Sometimes it is found that in a single engine there are a number of causes of excessive smoke all of which may not be diagnosed during the first inspection but are arrived at by a process of elimination as a result of repeated visits. Upon occasion, the follow up action takes the examiner from the operator to the pump specialist in order to obtain this information and may indeed also involve the specialist who serviced the equipment on the previous occasion. An attempt is being made at Ministry Headquarters to collate such reliable information as is available in order to try and establish an overall picture of the sort of problems and defects involved but the process is bound to be a lengthy one if it is to provide worth while information.

Enforcement by the Police

The Police are already able to take action under the provisions of the Motor Vehicles (Construction and Use) Regulations 1963. Regulation 22 says "Every motor vehicle shall be so constructed that no avoidable smoke or visible vapour is emitted therefrom". Although this Regulation was originally intended to deal with the steam propelled vehicle it is equally applicable to later forms of propulsion; the compression ignition engine of today is however not normally a congenital "smoker". Regulation 23 was introduced specifically to deal with the possibility of improper use of the excess fuel device of a compression ignition engine—a device which is the equivalent of the choke of a petrol engine. The Regulation requires with certain provisos that the devices shall be fitted in such a position that it is not accessible to the driver when he is driving. In addition to any action which the Police may take the Department's vehicle examiners when inspecting vehicles check this particular point and warn the driver if in any particular instance they are of the opinion that the provisions of the Regulation are not being met. The warning has usually been heeded by the time the vehicle examiner next sees the vehicle.

The preceding two regulations are in the "construction" part of the regulations and their much more frequently used counterparts in the "use" part of the regulations are regulations 80 and 81. Regulation 80 is concerned with the use on the road of a vehicle which is emitting amongst other things "smoke" and Regulation 81 requires in sub paragraph (a) proper maintenance of the excess fuel device and deals in sub paragraph (b) with improper use of the device. It is here that enforcement becomes more difficult at the present time particularly in respect of Regulation 80 where it is necessary to prove likelihood of causing damage, injury or danger with the proof depending upon the subjective impressions of the policeman concerned. With regard to Regulation 81 contravention of sub paragraph (a) can be established on factual evidence but in the case of sub paragraph (b) proof of contravention is likely to depend upon whether the existence of excessive "smoke" can be established which again involves reliance on subjective impressions. In consequence the Department has for some time now been considering the possibilities of quantifying "excessive" black smoke by for instance such means as an instrument measurement against a published standard but examination so far has made it clear such a procedure is not without its problems. At the present time it appears possible to evaluate smoke either by chemical analysis or by reference to the density or "blackness" of the smoke. Of these three methods the last two offer the most practical possibilities and instruments exist in this country for making such measurements.

Smoke meters

Instruments which measure the density of the smoke rely basically upon a light from a known source being transmitted to a calibrated photo-electric cell which is a fixed distance away from the light source and whose output, depending upon the amount of light falling upon it is recorded on a suitably graduated instrument. The instrument is first set to zero by passing clean air through it and a reading is then taken by substituting exhaust smoke for clean air and measuring on the instrument the degree of obscuration which will lie somewhere between zero and 100 per cent, the latter representing total obscuration of light.

Instruments which measure the "blackness" of the smoke usually depend upon extracting a known volume of the smoke through a filter paper of specified quality such that virtually all the solid particles in the smoke sample are deposited on the surface of the filter paper. The "blackness" of the stain on the filter paper is then evaluated by projecting at it a beam of light of known intensity and measuring on a suitably graduated instrument the amount of light reflected back. The instrument is zeroed by reference to the amount of light reflected from a clean filter paper and the other end of the scale is determined by the total absence of any reflected light.

Both forms of instrument rely upon sampling the exhaust smoke and require to be physically attached to the exhaust pipe of the vehicle involved. Under controlled conditions such as exist on an engine test bed in a manufacturer's premises where load and speed can be adjusted to give varying degrees of smoke up to the maximum of which the engine is capable both types of instrument can be used satisfactorily to give reliable indications of smoke levels but their use at the roadside creates a number of additional problems. Not least of these is the need to stop the vehicle and attach the instrument to it. In addition experience has shown that the bulkier instruments with their associated piping are difficult to accommodate on the vehicle and where in the interests of accurate measurements a separate source of electrical energy is necessary for operating the instrument this is an added difficulty as a sizeable battery may have to be accommodated in addition to the instrument itself. Carrying out a test of smoke density by driving the vehicle on the road besides being undesirable in itself from a traffic point of view is likely to require the services of two vehicle examiners—one to operate the instrument and note any readings and the other to drive the vehicle in order to be satisfied that the maximum smoke of which the vehicle is capable is actually being produced because as has been mentioned earlier it is quite possible to drive a vehicle in such a way as to produce less than the maximum smoke which it may be capable of making on the road. Any test which requires the vehicle to be driven on the road with the instrument on board is likely to be time consuming and there is also the disadvantage that only limited control can be exercised over the load and speed of the engine and in consequence there can be no certainty that readings are taken under representative conditions. Because of these various difficulties, consideration has also been given to the possibility of a form of test carried out without the need for having the instruments carried on the vehicle while it is being driven on the road. At the present time the only practical test of this nature of which we are aware is what is called "The Free Acceleration Test" and is currently being employed in Belgium. This test which was also referred to at Scarborough last year consists of rapidly accelerating the engine when in neutral from tickover speed to maximum governed speed and noting the maximum smoke reading on an instrument capable of indicating transitory conditions. The test is repeated several times in quick succession to establish a stable maximum which is then regarded as a reasonably representative indication of the maximum smoke potential of the vehicle. Here again, however, tests have indicated that there are difficulties in devising an arbitrary test of this nature which is truly indicative of the performance on the road but because of the practical advantages of such a procedure for roadside checks it is clear that the possibility cannot be summarily dismissed.

The Future

Ideally, we would like to have an instrument which did not require to be attached to the vehicle but was able to take a spot reading when used by an observer either at the roadside or in a following car for instance, so as to have a clear view of the vehicle's exhaust. Photographic methods are unreliable and we know of no suitable instrument at the present time. There are also a number of obvious and fundamental difficulties in the way of producing one, including the fact that exhaust gases are not expelled at any standard position on the vehicle—at the present time they are emitted at either side or underneath and may have become substantially dispersed before they can be observed. Then there is the need to focus accurately on a moving target at a specified point in the exhaust plume before dispersion takes place and to hold the instrument on this target long enough to get a satisfactory reading and to do this in all sorts of weather conditions and against a variable background. Nevertheless, because of the very obvious advantage of being able to get a direct reading of smoke under normal conditions of operation and believing that the numerous difficulties already referred to can eventually be overcome consideration is being given to the possibility of employing one or other of a number of modern techniques which might conceivably be applied in this way. If as a result of this consideration it is possible to provide practical means of this nature capable of measuring black smoke in terms of objective standards we will have made an important advance in our campaign against smoking vehicles and we are keenly interested in research to this end.

Meanwhile our most effective weapon against smoke is the body of vehicle examiners whose training in observing smoking vehicles enables them to pick out the bad ones as soon as they come into view and whose experienced judgment in this matter is seldom questioned. Their power to issue a notice prohibiting a vehicle from carrying goods either with delayed effect, or immediately, provides a strong deterrent to those operators who are otherwise likely to permit vehicles to go on the road in a condition which may cause them to smoke, and loss of use of a vehicle owing to a prohibition notice is probably a quicker and more effective way of making such an operator conscious of the importance of proper maintenance than a prosecution before the Courts which may result in a fine. The ability to prosecute does not depend upon the existence of a prescribed standard of smoke emission related to an acceptable method of test and measuring instrument but Court action would be greatly facilitated thereby. We shall however continue to make the greatest possible use of vehicle examiners not only for carrying out roadside smoke checks but also for the all important follow up action resulting from those checks. Experience has shown that this is the most effective way of bringing home to both operators and drivers of diesel engined goods vehicles their responsibility for avoiding smoke and thus reducing air pollution.

Discussion

Dr. L. E. Reed (Warren Spring Laboratory) in opening the discussion, said Mr. Fawell's paper was very welcome because it laid down firmly the Ministry's policy towards smoke from diesel engines and quite rightly relegated it to the foot of the table as a source of pollution compared with other fuel burning appliances and confined mainly to the streets. Although the concentrations of pollutants encountered as a result of these emissions might not reach dangerous levels, they might make an appreciable contribution to local pollution—this applied to both petrol and diesel engines. Some measurements of diesel engine emission made by Warren Spring Laboratory about three years ago in Archway Road, London, indicated that, on a calm day in summer, the concentrations of smoke near the roadside could be as great as those experienced by the inhabitants of a town in winter. Diesel smoke was about four times dirtier than normal urban smoke and this meant that people living on congested roads in built up areas, especially on hilly roads, were subjected to more pollution than the rest of the community.

Although the Ministry might feel that they were only able to combat diesel smoke if approached from the road safety aspect, that is if the smoke obscured visibility, this policy might not noticeably improve roadside conditions. This was because most diesel vehicles emitted smoke underneath the vehicle and by the time it emerged it had been well dispersed by transit turbulence; the smoke was still present but as it had been diluted about 10 times it was less visible. In fact the present policy could encourage the development of a means of diluting and emitting the exhaust in such a manner that it was rapidly dispersed without obscuring visibility.

Mr. Fawell had enumerated the causes of diesel smoke and pointed out most of them were avoidable, lack of maintenance and poor operation being the major causes. Warren Spring, in conjunction with the Ministry of Transport, had made roadside checks of vehicles by using a smokemeter. In the case of vehicles emitting heavy smoke there were often much more serious mechanical defects—faulty brakes, split tyres, defective steering, etc. Thus excessive smoke might often be taken as an indication that, due to lack of maintenance, the vehicle was a positive menace on the road. The public had welcomed wholeheartedly the Ministry's spot checks that were being carried out and the scheme for the regular inspection of goods vehicles along the lines carried out in other European countries.

Dr. Reed called for a consideration of control methods and said the operator always got the blame for smoke emitted on the road, but even the best of them could not emit less smoke from their vehicles than that inherent in the design produced by the engine manufacturer. The manufacturer had, therefore, to shoulder his share of responsibility in producing engines that were capable of a prescribed power output without emitting smoke of more than a specified density. The B.S.I. committee referred to might eventually help by prescribing limits for new diesel vehicles. To obtain information that would be of help to both this committee and the Ministry, Warren Spring Laboratory and the Motor Industry Research Association had recently conducted a series of tests to find out how much smoke the public would tolerate, the results of which had just been published elsewhere. If the limit that 75 per cent of the public objected to was taken and compared with the smoke measured from a number of vehicles at the roadside, then it suggested that the number of potentially smoky vehicles was very much higher than the figure of 12 per cent, quoted by the Ministry, as actually emitting excessive smoke. This did not mean that the vehicles were all emitting smoke continuously, but only that they were capable of doing so if the correct load and operating conditions prevailed.

Diesel smoke had been a frequent topic at this Conference and a few years ago it was thought that provided sufficient publicity was given to the causes of smoke the necessary remedies would be applied. Unfortunately despite widespread publicity diesel smoke was still with us and sterner measures were necessary. Even when regular inspections of vehicles were introduced some roadside checking would still be necessary. Instrumental methods were available which would pick out the worst offenders but this would involve specifying limits which could not be exceeded. It might be preferable to leave the method vague, as it was at present, and depend entirely on the ability of trained engineers to decide whether a vehicle was faulty or not. A well trained observer was almost as good as a smokemeter and he was very pleased to see that the Ministry's team of vehicle examiners had been greatly increased. By the spot checks already instituted a good beginning had already been made and many of the gross offenders had been eliminated. There was however, no reason for complacency and resolute action was required by the Ministry, the manufacturer and the operator to give both safe and smoke-free vehicles on the road.

Dr. Reed then commented on the report of the Technical Committee of the Society and described it as an excellent summary of the position today regarding sulphur dioxide. Whether or not it was encouraging depended upon one's viewpoint. The fact that the emission had increased by over 20 per cent, mostly from generating stations, in the last eight years without producing any detectable increases in ground level concentrations was certainly encouraging. On the other hand the prospect for reducing these concentrations was not encouraging. Nuclear power had been suggested as a source of sulphur-free power. This was quite true, but present nuclear plants did emit minute quantities of a radioactive argon so that even they were not completely pollution free. The possibilities of flue gas washing were discussed fairly and, as was pointed out, any foreseeable process would only be applicable to large plant such as power stations. Current lines of research were concentrated on dry processes; Warren Spring had been examining the Reinluft process mentioned in the paper and shown that it could be operated on a small scale continuously removing over 90 per cent of the sulphur dioxide in the flue gas. However if scaled up in its present form, the size of the plant for sulphur dioxide removal would occupy almost as much space as the remainder of the power station. Obviously there was a great deal of chemical engineering work to be done to achieve a reasonable plant size.

Section 5 of the report was probably the most important as it described the only practicable method of keeping sulphur dioxide pollution within reasonable limits; that was by dispersing it into the atmosphere. He felt there was a tendency to overstress the importance of the efflux velocity of gas leaving the chimney. The main object should be to build the chimney of the correct height and then have the velocity high enough to carry the gases clear of the chimney. Excessively high velocities were costly in fan power and reducing the chimney height by increasing the efflux velocity was not to be encouraged. As the report said, discharging all the gases through a single chimney was preferable to having several chimneys, but unfortunately the plume rise obtained did not seem to be as great as was expected. The recent work of Lucas, Moore and Spurr on the plumes from power station chimneys suggested that its rise was dependent only on the heat content of the plume to the ¼ power; *e.g.* if the volume of gas or its temperature were doubled the plume rise was increased by only 20 per cent. This increase was not negligible, but it was not as great as that calculated by the use of other formulae.

He was pleased to see that the report came out quite openly in favour of chimneys rather than architectural considerations, a viewpoint he was sure the conference would endorse. However, there was no mention of the equally thorny problem—the erection of tall blocks of flats near existing large chimneys. Perhaps more emphasis could have been given to the siting of large sources in such a way that the pollutants were dispersed. Particular care should be given to sources in a valley where the accumulation of pollutants in a night time inversion might lead to serious pollution under fumigation conditions when the inversion broke up. Alternatively a multiplicity of sources in a valley might give an additive effect when the wind was blowing in certain directions.

In Czechoslovakia the power stations were sited on the brown coal seams in the valleys of N.W. Bohemia. The pine forests on the sides and crests of the valleys, often miles from the sources, were being killed by sulphur dioxide. In fact, the yearly average experienced was often five times the average figure for London. This did show that adverse siting was an important factor to be watched. Every time a new power station was proposed, an enormous outcry followed because its effluent might lead to increased levels of sulphur dioxide in the neighbourhood. It was known that most of the smoke and probably at least 50 per cent of the sulphur dioxide found at ground level arose from domestic fires. The report indicated that district heating or similar schemes could reduce the pollution to 1/100th of its present value. Surely the time had come to obtain some proper estimates of the cost of sulphur dioxide pollution in terms of health damage and loss of amenity so that we knew how much we could afford to spend to reduce it. It might be more advantageous to worry less about sulphur dioxide from power stations and examine sources nearer home.

S. C. Beaumont (Birmingham) referred to Dr. Parker's Presidential Address in which it was indicated that the annual emission of sulphur dioxide into the atmosphere was estimated to be one and a half million tons, three times greater than it was in 1956, and it had been said that although the emission of SO_2 was increasing there appeared to be little increase in ground level concentrations as most of the gas was emitted from tall chimneys and passed harmlessly away. However, not many of the chimneys were high enough to extend above the inversion layer and ensure complete dispersal of the gases; tragedy had occurred before and could again, unless measures were taken to prevent it. The Memorandum on chimney heights was issued as a guidance on what chimney heights should be, but Town Planning Departments had their own views on this matter.

An increasing quantity of oil was being used in this country and the industrial oils being burned had a sulphur content of 4 per cent or more. The oil industry were not indifferent to the concern of many people about this problem. Many authorities appreciated the help and assistance given by the oil industry towards the reduction of visible pollution; the industry had done a great deal for the cause of clean air, and he was sure it was not beyond their resources to overcome the problem of reducing the emission of sulphur dioxide. The Sulphur Dioxide Report had said "The removal of sulphur from heavy oil fuel would be expensive and although it cannot at present be urged, it is hoped that economical methods of doing this may be developed". He was of the opinion that the removal of sulphur should be urged. It might be economically impracticable to remove sulphur completely, nevertheless a reasonable reduction would be better than nothing and gave as an example the steel industry's use of heavy oil that had a sulphur content of less than two per cent.

Dr. J. H. Hudson (Dartford) said that although there was no prospect of early elimination of SO_2 the control of smoke might remove the means by which this gas might cause injury. He outlined an analogy between lung damage and malaria. Malaria came under effective control by elimination of the anopheline mosquito 50 years before the disease was eradicated in certain areas by elimination of the malaria parasite. Similarly if SO_2 caused lung damage such disease might come under effective control by elimination of the carbonaceous smoke although we might have to wait 50 years before elimination of SO_2 became possible.

Dr. S. R. Craxford (Warren Spring Laboratory) referring to the SO_2 report's reference to chimney height and the siting of industry, drew attention to the recent calculations of trends of air pollution made by Mrs. M.-L. P. M. Weatherley which showed that for urban areas, excluding London, the concentration of sulphur dioxide in the air near ground level had decreased by some 15 per cent since 1959-60, whereas the total emission increased over the last six years by about 10 per cent. For London for the same periods there was no detectable change in the ground level concentration (if anything a very slight decrease) while the emission increased by 30 to 40 per cent. These figures formed a striking tribute to the success of the planning measures that had already been taken, in particular, to the use of adequate chimneys and provided a happy augury for the future.

D. Lister (Northumberland C.C.) said drivers should be encouraged to report to their employers when vehicles smoked and in this connection repeated a suggestion he first made in 1957 that, either by compulsion or by agreement among manufacturers, the exhaust pipe outlet of a commercial vehicle should be made visible from the driving seat, by a mirror or other means. He did not, however, go all the way with Mr. Fawell's remarks on prevention of smoke by driving technique. In his opinion, if a vehicle could be made to smoke by any normal method of driving it, then it was out of adjustment in the first place and the fault did not lie with the driver. There were, of course, special circumstances such as a fault developing in the course of a journey and causing smoke, when a vehicle might have to be "nursed" home, but otherwise smoke should not have to be a driver's responsibility.

He was glad to note Mr. Fawell did not rule out the use of a smoke-meter in enforcement work, and drew attention to the experiments now being carried out by the Manchester City Police. He was also glad to note that some 2,900 summonses for smoke had been issued in England and Wales during 1963. There was room for both vehicle examiners and police in this field, but he had noticed recently among police a desire for some more objective method of smoke assessment to assist them in this work.

Councillor C. Dimes (Stepney) spoke as a retired British Road Services driver. He said the fuel pump of a diesel engine was set by the manufacturer to ensure that the mixture of fuel and air was correct. Provided the loading was correct little smoke would be discharged from an engine so adjusted except when hill-climbing. Unscrupulous drivers interfered with fuel pumps and the subsequent racing of the engine resulted in a discharge of dense black smoke. Road vehicle inspectors should pay particular attention to the load actually carried and not rely on the weight of load as stated in the driver's log book. Any disregard of safety measures should lead to the prosecution of the owner and also the driver for aiding and abetting.

Dr. K. Gräfe (City of Hamburg, West Germany) said that some German clean air officers thought it necessary to measure the SO_2 for one year and to evaluate the results in a statistical manner. In Hamburg they preferred the British method outlined in the Memorandum on Chimney Heights though the categories should be confirmed or altered after the results of SO_2 measurements had been received. He wondered whether the measuring of SO_2 concentrations at varying altitudes undertaken some years ago would be continued.

P. H. G. Grimmett (Wednesfield) said that in his view the recommendation of tall chimney stacks for the dissemination of SO_2 pollution was a negative attitude and that managements who agreed to the erection of such chimneys and the expenditure of such colossal amounts of money required, would resist very strongly development which could eradicate or remove such pollutant from the atmosphere.

Greater effort should be made to remove SO_2 at source and there should be a contribution from the National Health Service to meet the cost of such removal as this would ultimately result in a saving of medicaments in respect to respiratory illness. In commenting upon the words of Dr. Reed who had intimated that there should be an assessment of the cost of the particular damage occasioned, Mr. Grimmett made reference to the deaths from respiratory diseases which numbered, he understood, 44,000 per year in a similar age group to himself. This meant 1¼ million hours of work lost per week in respect to these particular people alone apart from the number of people who were on the sick list through respiratory difficulty.

Referring to the paper on road vehicle pollution, Mr. Grimmett asked if something could not be done about the noisy two-stroke engines which polluted the atmosphere and to which little attention appeared to have been given so far.

G. H. Mitchell (on behalf of C. W. Oliver, Road Haulage Association) wished to endorse much of Mr. Fawell's paper, but he felt that as usual anyone putting forward the views of the Ministry of Transport overlooked the fact that the operator could not use on the roads a better vehicle than the one supplied to him when new. Both the Ministry of Transport and operators knew that there were vehicles on the roads that were inherent smokers; designed so that as soon as the engine was working under load or under pressure they emitted smoke from the exhaust and no amount of maintenance in the world could change that situation. As reported at the Scarborough Conference the British Standards Institution had set up a Committee to consider the performance standard for diesel engines in road vehicles, but after 12 months there was little to report.

He felt it to be most unfair that operators of diesel road vehicles should be prosecuted while one of the major causes of black smoke from vehicles was the under-powering of engines. It was not unknown for drivers to tamper with governors to obtain greater power which inevitably produced more smoke. It now seemed that they would have to press for legislation to lay down a power-to-weight ratio in order to be sure that the well-maintained vehicle would not emit smoke when operating under load. Tentative suggestions of 6 h.p. per ton weight had already been made, and whilst not necessarily accepted many recent models were fitted with much higher h.p. engines. To indicate their interest in the problem of smoking exhausts, the Association (in conjunction with the T.R.T.A.) instituted a system of providing pads of cards to members printed in such a way as to enable them to quickly note details of any vehicle seen to be emitting smoke and post the card forthwith to the owner and where the owner was not known to send the card to the Association for forwarding. This mutual benefit scheme was operating quite successfully and Mr. Mitchell felt that there had been an improvement as not so many diesel engined vehicles emitted black smoke on the roads these days. One had to remember that one vehicle emitting black smoke was seen by many road users. He thought that as a result of the efforts of the N.S.C.A., Ministry of Transport's examiners and extra efforts by the members of the Road Haulage Association the situation was improving. He assured the Conference that his Association would not be happy until manufacturers were forced to provide an engine which would give good reliable service and not emit black smoke.

C. A. Roast (Esso Petroleum Company Limited) said that the oil companies were most sympathetic to the aims and objectives of the Clean Air Society. They devoted a substantial amount of money and effort in an endeavour to ensure freedom from nuisance wherever petroleum products were employed. Qualified technologists were available to assist wherever necessary, but unfortunately many a local nuisance had arisen from a poorly designed boiler flueway system. It was on that account that he made an appeal to the delegates to bear in mind that the memorandum on Chimney Heights issued by the Ministry of Housing and Local Government, was in effect, an overall means of guidance, and should not be employed as a mathematically precise way of reaching a final decision on the height of a specific chimney. Nor, for that matter, should Clause 10, which indicated some advantages in combining emissions, be employed without careful consideration of all the relevant factors. A good example of poor guidance in that respect was a well-known building where a common chimney was employed for four boilers, each rated at 14,000 lbs. of steam per hour. Even when all boilers were on full load, the chimney exit velocity would hardly exceed 15 feet per second. The fact that this boiler plant would be running on relatively low loads during the night and throughout the summer months seemed to have been disregarded. On such occasions the maximum boiler load was less than 6,000 lbs. of steam per hour, with a resultant chimney efflux velocity of less than two feet per second. The Society's Technical Committee would recognize the effect of this low velocity on flueway gas temperatures, and in such circumstances there was little doubt that the energy remaining in the gases after they left the chimney would be so low that a local nuisance would be inevitable. Quite recently a similar form of complaint in the South Wales area was investigated, and once again the single chimney arrangement was almost entirely responsible.

The recommendation given in the memorandum could best be applied to an industrial boiler plant where base load conditions prevail throughout the entire steam period; where the load was variable, it was best for each boiler to have a separate chimney which might well be within a common casing or outer structure. There could be no doubt that the design requirements of a flueway system which, incidentally, would also include the chimney, was to some extent specialized, and in view of the wide range of technologies covered by a Public Health Inspector, it would be unreasonable to expect him to be an expert on all those subjects. The major oil companies offered a highly specialized degree of technical assistance in all matters appertaining to the utilization of their products, and he asked all concerned to contact one of the major company's technical departments whenever any element of doubt prevailed upon the design requirements of a new oil burning installation.

Councillor E. C. Pepperdine (Welton R.D.C.) asked if it might be possible to use a Gold Visibility Meter to measure the blackness of diesel smoke. With regard to the Sulphur Dioxide Report he said that higher chimneys would have such little effect on current concentrations at ground level that the expected and reasonable opposition on aesthetic grounds outweighed the advantages likely to be gained from such a policy. He therefore stressed that the main policy of the Society should remain as the elimination of toxic gases at source, and because of downwind drift a National Smoke and Toxic Gases Control Zone should be sought, with the ultimate aim being international extensions of such a zone.

Councillor R. Horsfield (Dover) said it was obvious that power/weight ratios were of primary concern and the first essential must be the efficiency of the motive power in relation to the work demanded, so as to lessen the inclination of operators to overload and the need for drivers to depress accelerators in order to get the maximum power out of their machines regardless of smoke, and enable them to maintain their position in the line of up grade traffic in one or more lanes.

Having got the correct power unit, nothing but first-class maintenance should be tolerated, and when that was not prevalent smoke checks should come to the fore with their classification of heavy, medium or light, and the Ministry of Transport prohibition applied drastically. The loss of a vehicle was the quickest way to make all operators conscious of the paramount importance of adequate maintenance.

From the road safety angle every user of the highway looked forward to the introduction of annual inspection and certification of goods vehicles in precisely the same manner as private cars were now dealt with; with revenue licence issue being wholly dependent thereon.

Author's Reply

Mr. H. D. Fawell replying to the discussion said that he could not accept Dr. Reed's suggestion that the Ministry's approach was limited to the road safety aspect. The follow up activities of Vehicle Examiners ensured in most cases that the cause of the smoke was traced and eliminated. This aspect of the campaign against smoke was, if anything, more important than enforcement either by prohibition or police court action.

With regard to the point that "heavy smokers" were also mechanically defective, it was probably true to say that a vehicle having serious mechanical defects might also be a "heavy smoker" but the reverse was not necessarily true.

He agreed with Dr. Reed that in the first place, it was the responsibility of manufacturers to produce vehicles with engines having adequate power output without emitting smoke.

The percentage figures for smoking vehicles quoted by the Ministry from time to time in their Reports, were necessarily based on those vehicles actually seen to be smoking. It was appreciated that some of the vehicles which passed the check point might be capable of making smoke in other circumstances at some other time but one could not legislate for this sort of probability—it would be like saying that a vehicle was a potential offender because it was capable of exceeding the speed limit.

Mr. Fawell assured Dr. Reed that there was no complacency about the results achieved so far, and the Ministry's various activities with regard to smoke control would continue to be pressed forward.

With regard to Mr. Lister's suggestion that the exhaust outlet should be visible to the driver from his seat, Mr. Fawell said that he understood that one manufacturer of quantity produced commercial vehicles was experimenting with an exhaust smoke detector which would give a warning to the driver when exhaust smoke exceeded some pre-arranged density. As to driving techniques, he did not wish to give the impression that a driver should be expected to make amends for faulty adjustment or poor maintenance—he could do no better than the vehicle with which he was provided would allow—but there were circumstances when good driving technique could alleviate the nuisance of smoke.

The various matters such as interference with fuel pumps, overloading, power/weight ratios, effective maintenance and annual inspections which were referred to by Councillor Dimes and Councillor Horsfield were all important factors in dealing with the overall problem of exhaust smoke and Mr. Fawell again reminded the Conference of the Ministry's various proposals for dealing with them. He also thanked Councillor Pepperdine for drawing his attention to the possible use of a Gold Visibility Meter to measure black smoke.

Mr. Fawell said that perhaps he was less pessimistic than Mr. Mitchell appeared to be with regard to the outcome of the work of the Technical Committee of the British Standards Institution which was considering the performance standards for diesel engines in road vehicles. He felt that a combined operation was necessary to bring about a satisfactory solution of the smoke problem. There was a need for manufacturers to produce vehicles fitted with engines having an adequate power output and adjusted to give that power without making undue smoke, for operators to maintain those vehicles in a condition which permitted them to perform in the way the manufacturer intended, and for drivers not to upset the performance of a well designed and properly maintained product by tampering with various items of the equipment in the hope of making some improvement. He was glad to have information about the system instituted by the R.H.A. and the T.R.T.A. whereby operators advised each other of smoking vehicles and it was encouraging to know that the scheme appeared to be operating successfully.

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HARROGATE CONFERENCE

20th–23rd October, 1964

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National Society for Clean Air

Harrogate Conference, 1964

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Folkestone
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Frimley & Camberley
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A. J. Desbrow (Dep. CPHI)
Fulham
Cllr. J. M. Browning
F. C. Payne (PHI and Officer for Smoke Abatement and Factories)

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C. Cooper (CPHI)
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Ince-in-Makerfield
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Cllr. Mrs. V. M. Hope
A. R. Metcalfe (CPHI)
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Dr. H. C. Weir (MOH)

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J. Page (SI)
Kirkintilloch
Provost Mrs. Janet M. Coutts
J. Curran
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F. E. Terry (SPHI)
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Leek
Dr. H. E. Wilson (MOH)
Lees
J. W. Rustidge (PHI/Surveyor)
Leicester
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Lewisham
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Lincoln
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Liverpool
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Prof. A. B. Semple (MOH)
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J. Clancey (Chief Insp. Public Health Dept.)
Londonderry
E. G. Drayson (Executive Sanitary Officer)
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R. Lord (Dep. CPHI)

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W. Turner (CPHI)
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Motherwell & Wishaw
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Mountain Ash
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L. R. Griffiths (Building Surveyor)
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F. Winder (CPHI)
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G. Wilson (CPHI)
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Sunderland R.D.C.
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D. E. Donald
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Cllr. J. Randerson
E. Fuller (PHI)
Swinton & Pendlebury
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A. Gillibrand (CPHI)

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Todmorden
C. Baxter (CPHI)
J. Highley (Tech. Asst.)
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Dr. G. Hamilton Hogben (MOH)
Tottington
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Tredegar
H. Davies
O. Griffiths (SPHI)
Twickenham
H. D. Smith (Dep. CPHI)
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Cllr. A. Birtle
K. Hilton (SPHI)
Tyrone C.C.
J. A. E. Standing (Div. PHI)

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E. W. Ward (CPHI)
Warrington R.D.C.
Cllr. L. Ware
W. A. Morrison (CPHI and Cleansing Supt.)
Warwick
S. H. West (Dept. CPHI)
Warwick R.D.C.
Cllr. Mrs. M. Morss
Dr. F. D. M. Livingstone (MOH)
Warwickshire C.C.
Cty. Ald. P. L. Jewsbury
K. L. Spence (Cty. HI)
Washington
Cllr. C. McIlroy

Watford R.D.C.
Cllr. E. H. Nimmo
S. N. Grigg (CPHI)
Wednesfield
Cllr. B. D. Gandy
P. H. G. Grimmett (CPHI)
Wellington (Salop) R.D.C.
Cllr. R. Hutchinson, J.P.
D. S. Fry (PHI and Dep. Surveyor)
Welton R.D.C.
Cllr. E. C. Pepperdine
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Dr. Marjory A. Dawson (Dep. MOH)
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Cllr. A. Smith
H. Corscadden (CPHI)
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Cllr. H. Rudge
H. E. T. Lowbridge (CPHI)
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G. H. Cockell (CPHI)
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G. Steed
Wombwell
Cllr. H. Wilkinson
J. Finney (CPHI)
Wood Green
F. James (CPHI)
Woolwich
Cllr. H. F. Reilly
F. A. Andrew (CPHI)
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Ald. Mrs. F. R. Ratcliffe
Ald. H. H. Exall
Worksop R.D.C.
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Worsbrough
Cllr. R. Atkinson, B.E.M., J.P.
G. E. Robinson (Asst. Clerk)
Worsley
Cllr. J. E. Stell
F. Haworth (CPHI)
Wortley R.D.C.
Cllr. T. Steel
G. Bennett (Asst. PHI)
Wrexham
Cllr. S. Davies
A. McCartney (CPHI)
Wrexham R.D.C.
Cllr. J. E. Powell
T. L. Williams (Clerk and Solicitor)
Wycombe R.D.C.
Cllr. G. Spear
B. R. Nagle (Dep. CPHI)

Yiewsley & West Drayton
Cllr. J. Rowe
A. Makin (CPHI)
York
Cllr. R. H. Glew
N. Hancock (CPHI)
York (North Riding) C.C.
Cty. Cllr. J. T. Walker
Dr. J. A. Fraser (Cty. MO)
Ystradgynlais R.D.C.
W. E. Jones (PHI)

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Appleby-Frodingham Steel Co.
W. J. Calvert
Association of Public Health Inspectors
T. H. Iddison
E. Dodsworth
U.K. Atomic Energy Authority
Dr. N. Spoor

Barnsley District Coking Co. Ltd.
H. Brook
R. T. V. Hunt
A. H. Bibbey (Sales) Ltd.
G. A. Wootten
J. J. B. Saul
BP Trading Co. Ltd.
W. C. Hopper
British Cast Iron Research Association
F. M. Shaw
British Coking Industry Association
G. E. Hall
British Iron and Steel Federation
I. C. Fowler
W. G. Jaffrey
British Medical Association
Dr. W. R. Martine, O.B.E., T.D.

Calor Gas (Distributing) Co. Ltd.
A. E. Barnbrooke
Cannon Industries Ltd.
G. I. Hoatson
D. Smith
Central Council for Health Education
Cllr. J. A. Brown, C.B.E., J.P.
Central Electricity Generating Board
G. N. Stone
A. J. Clarke
J. R. Taylor
F. R. Allen
W. B. Shannon
J. B. Stuart (Midlands Region)
M. C. Frankham (North Eastern Region)
R. Wolforth (North Eastern Region)
Coalite and Chemical Products Ltd.
Commander C. Buist, C.V.O., R.N.
F. L. Waring
J. H. Orr
R. Pane
Coal Merchants Federation of Wales
K. T. Diamond (Eastern Area)
Collectron Ltd.
J. M. Hodgson

Dorman Long (Steel) Ltd.
D. Jenney
Drummond Patents Ltd.
R. M. Drummond

Eastern Gas Board
C. A. Deas
East Midlands Electricity Board
P. G. Cope
P. G. Williamson
East Midlands Gas Board
J. B. Leaman
Electrical Association for Women
Miss Mary George, M.B.E.
Electrical Development Association
J. I. Bernard
W. G. Nattage
R. B. Partington
G. D. Metcalfe
H. E. Smith
Electricity Council
K. D. Roberts
A. E. Tooke
Elliott Process Automation Ltd.
R. Hussey
Esso Petroleum Co. Ltd.
M. J. Mahon
D. B. Dawson
D. F. Tripcony

Federation of British Cremation Authorities
J. W. Roberts
Ford Motor Co. Ltd.
G. R. Baldock

Gas Council
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H. B. Healy
S. L. Moppett

Hamworthy Oil Burning Ltd.
A. R. Berrett
J. Stewart
Hargreaves (West Riding) Ltd.
J. S. Brennan
Head Wrightson Iron and Steel Works Engineering Ltd.
P. E. Rooksby
A. Harvey
Heatstore Ltd.
H. J. Denning

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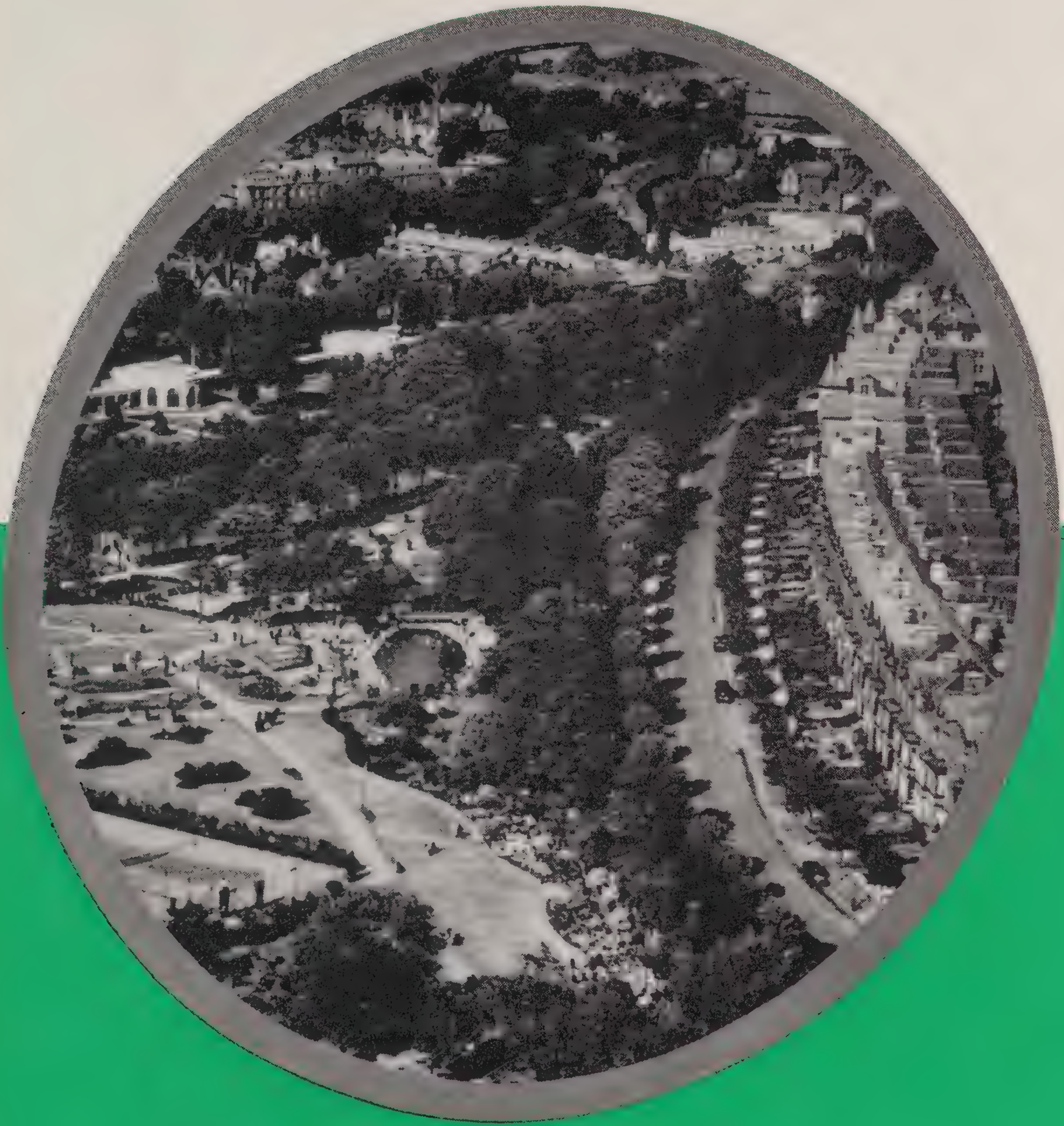

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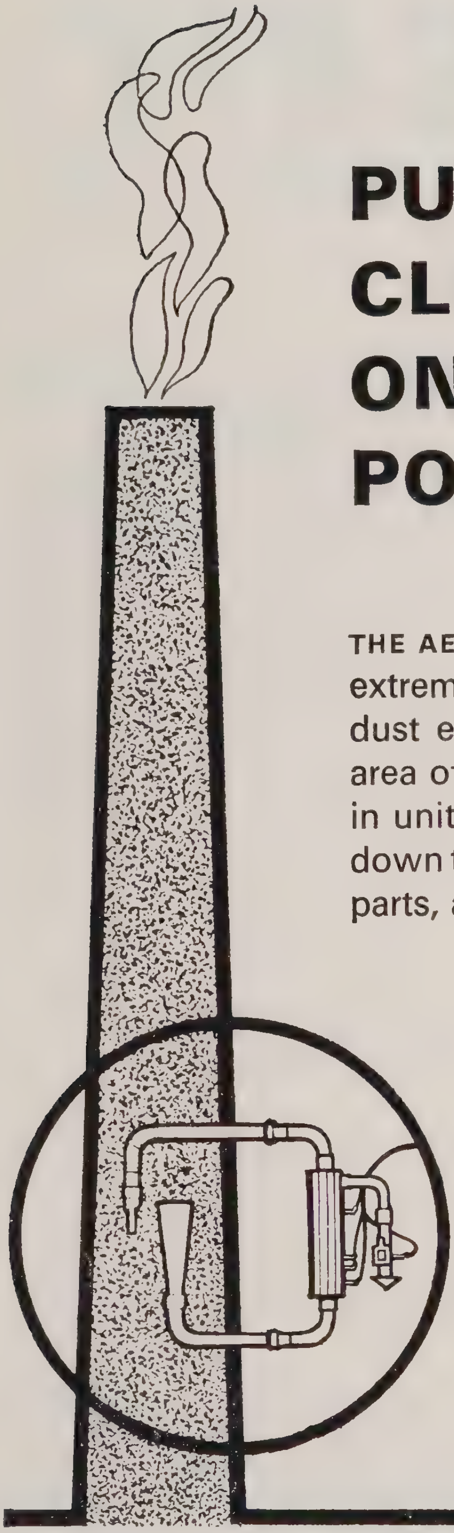

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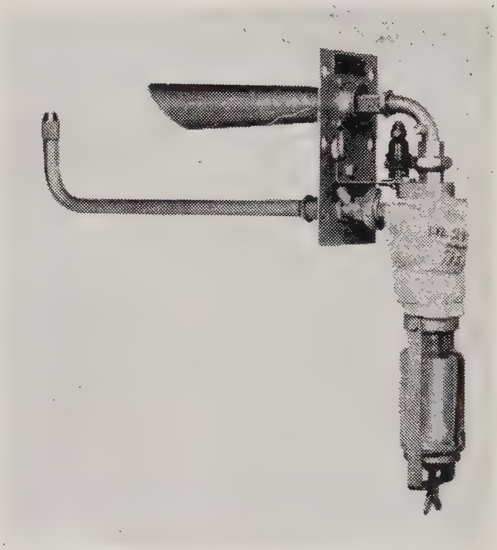

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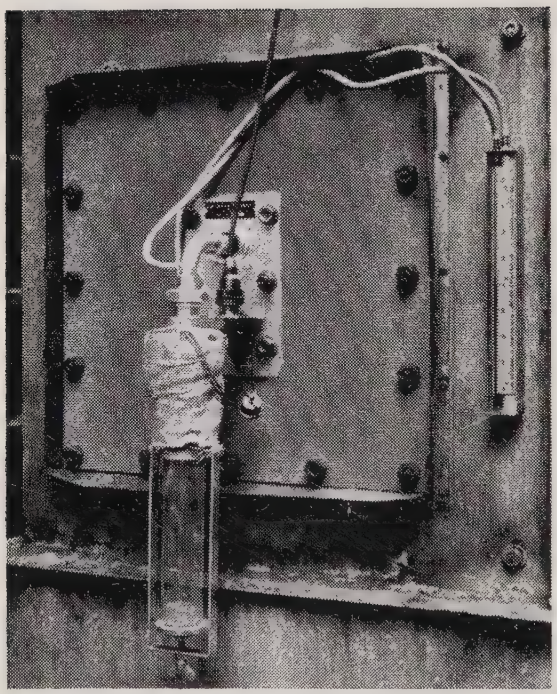

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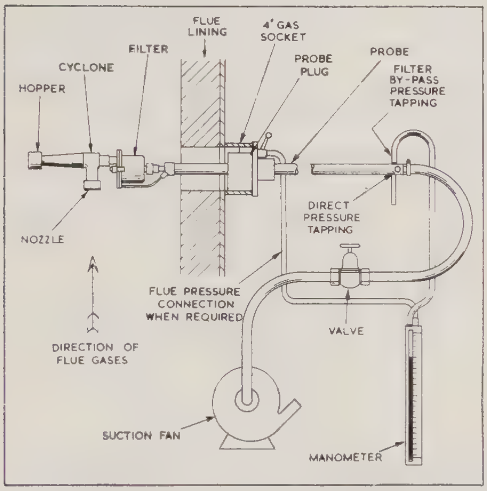

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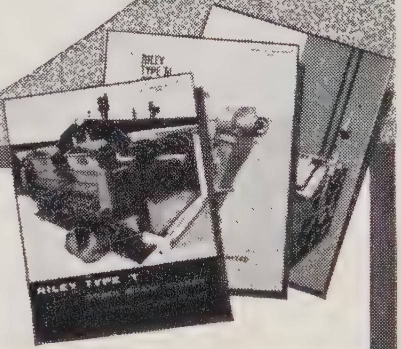

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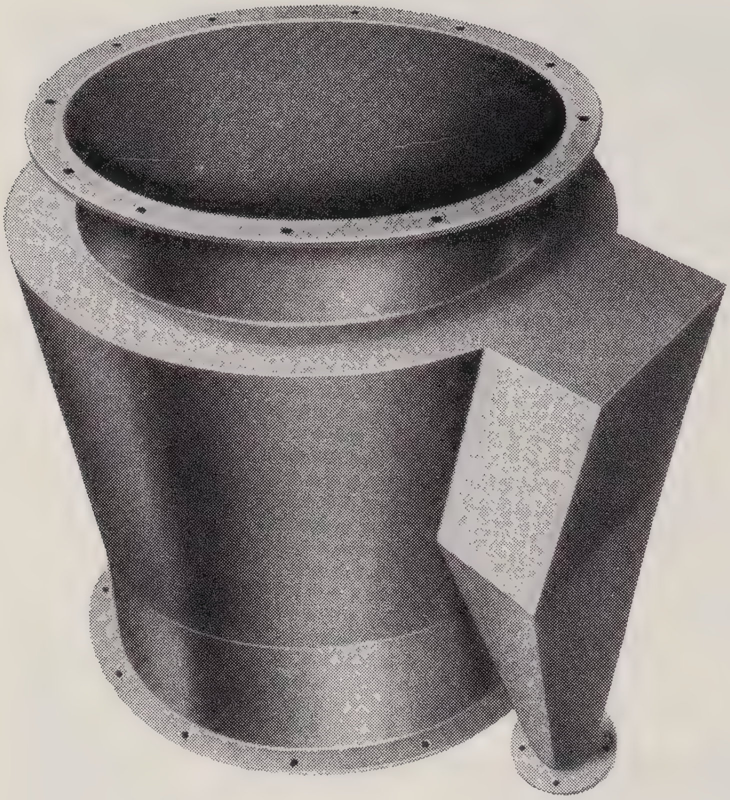

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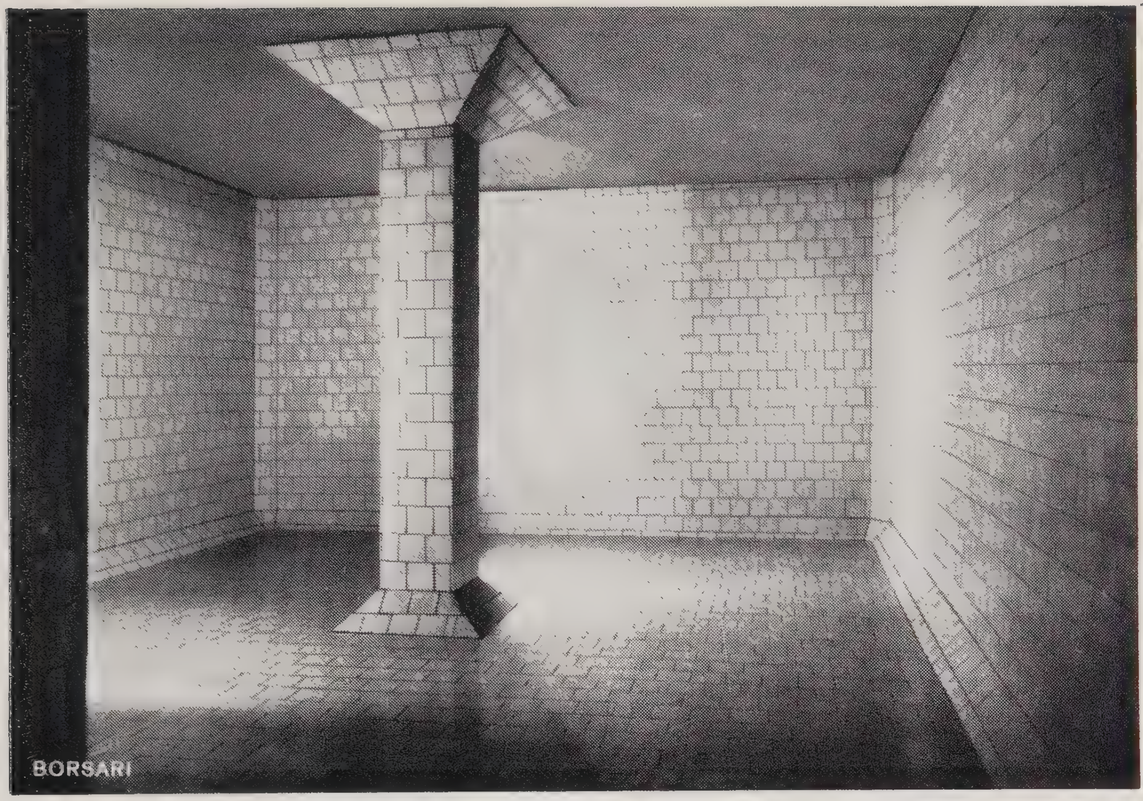

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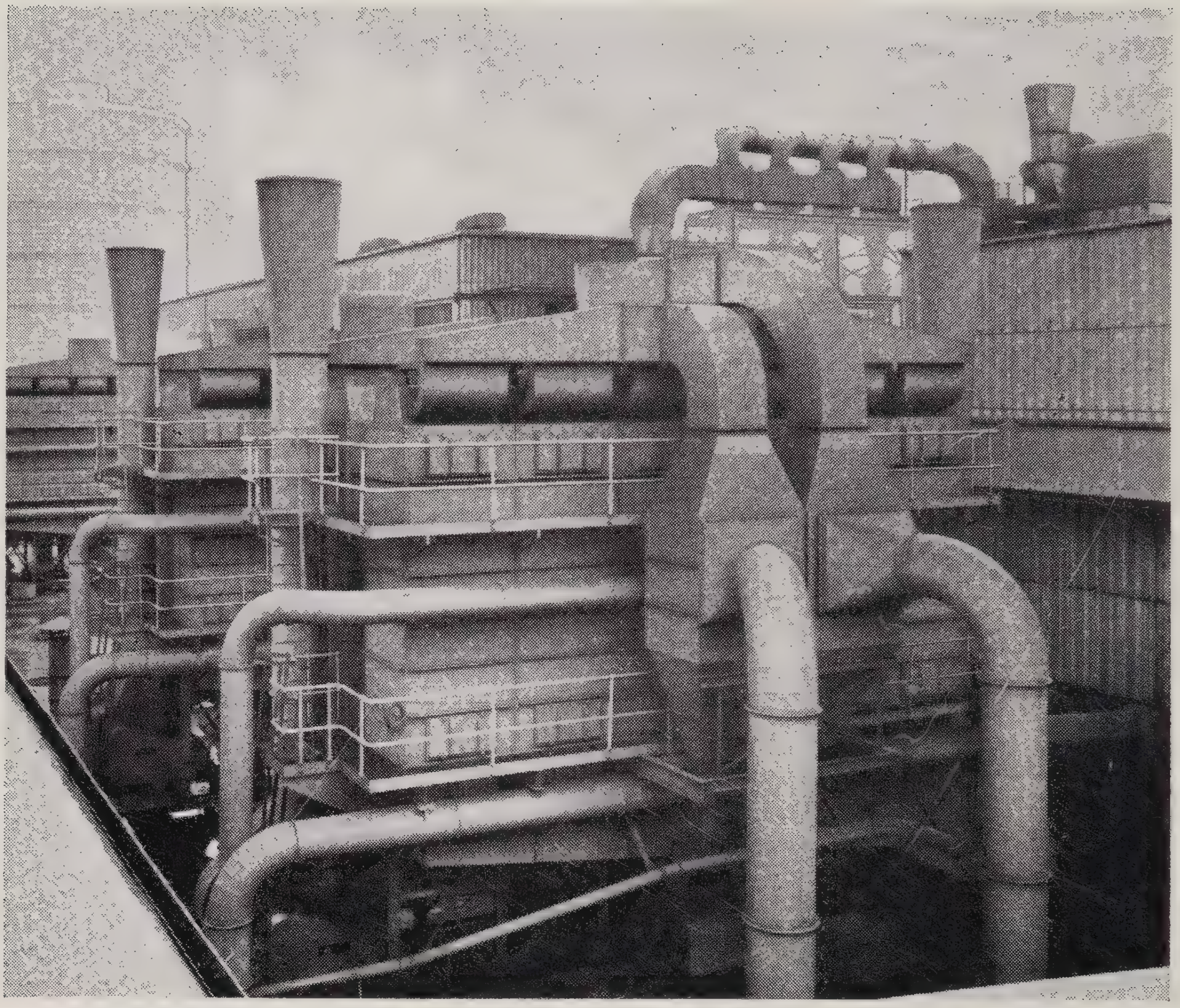

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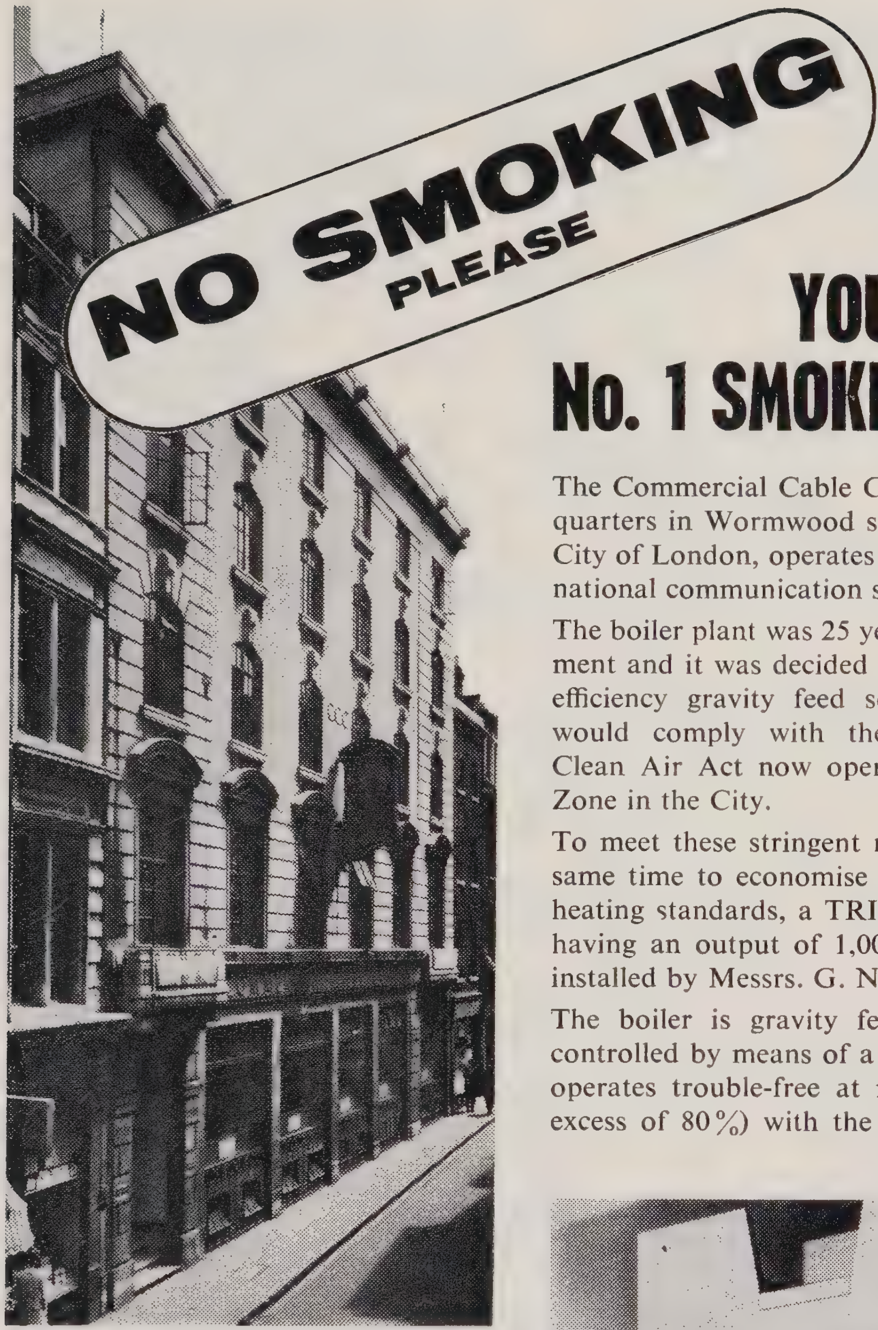

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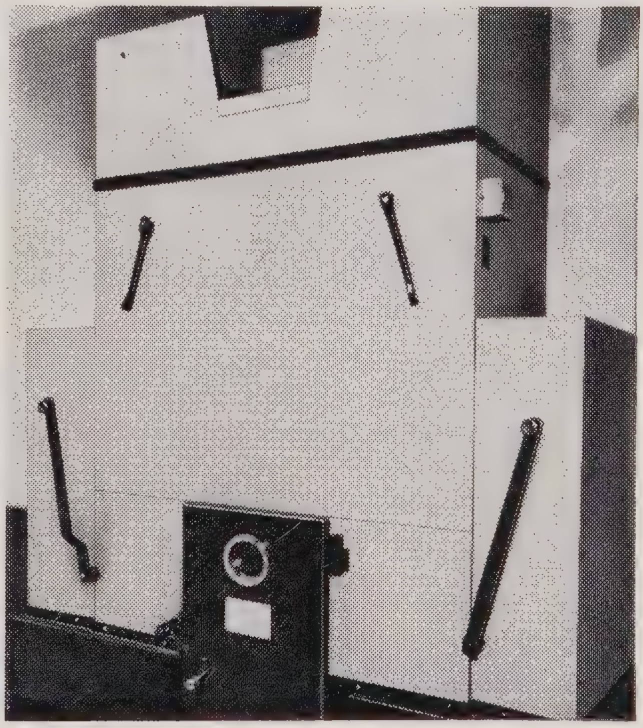

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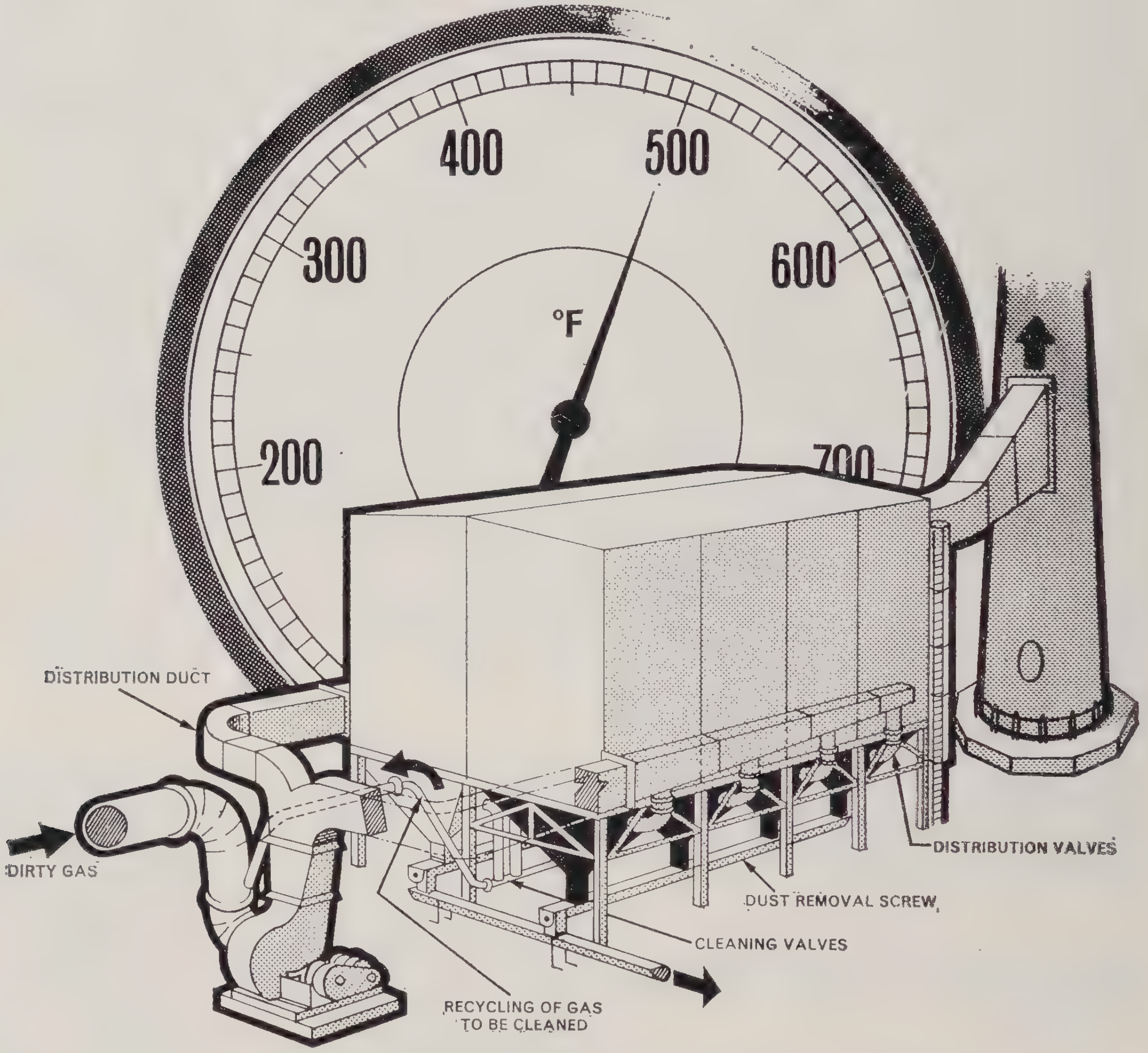

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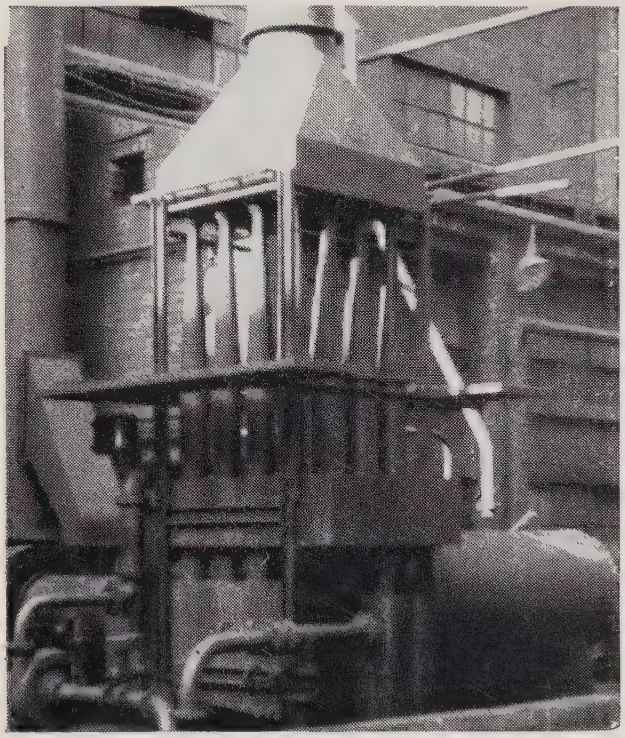

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Greetings from the Mayor

"TO travel hopefully is a better thing than to arrive. and the true success is to labour." So said Robert Louis Stevenson. This may be true of us in our individual efforts, but it is not true of a cause, and you are working for a cause.

My colleagues and I welcome you to Harrogate where you will discuss, in your Conference, the tremendous work which lies ahead of you, and take pleasure in the success you have achieved.

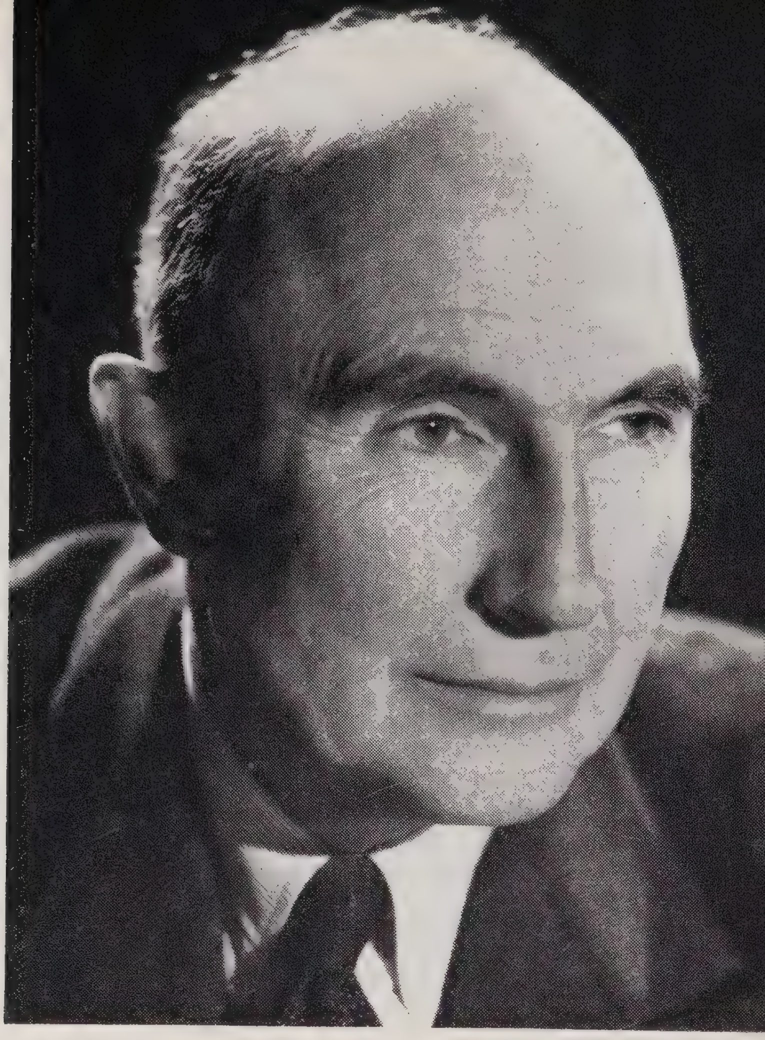
Your efforts have been bedevilled by the unexpected problems caused by a shortage of certain smokeless fuel, but your aim remains unchanged—to ensure that the people of this country shall breathe pure air, and that the appalling waste of life, and of money, caused by smoke-filled air, shall cease.

We hope that you will enjoy the beauty of Harrogate as you have enjoyed it on your previous visits. It is always a pleasure for us to welcome old friends.

Yours sincerely,
(Signed)
HAROLD S. HITCHEN
Mayor

The Mayor's Parlour,
Town Hall,
Harrogate.

Notes on the Conference



The Rt. Hon. Lord Sherfield

Lord Sherfield

THE General Election, with all its uncertainties of date and outcome, has prevented the Society from having a Minister to open the Conference as is usually the case. We are however very pleased and privileged to have The Rt. Hon. Lord Sherfield as our guest to address the first session and to declare open both the Conference and the Exhibition. Lord Sherfield will still be better known as Sir Roger Makins, who until recently was Chairman of the U.K. Atomic Energy Authority. He has had many other distinguished appointments, including that of Ambassador to the United States and with the League of Nations and the United Nations. Among other offices, he is Chairman of the Governing Body of the Imperial College of Science and Technology. The world of fuel and power will thus be exceptionally well represented at the Conference—a foremost authority on atomic energy on Tuesday morning, to be followed on Thursday by "top people" from the coal, gas, electricity, and oil industries.

The Mayor of Harrogate

The Mayor of the host town is an important person in the Conference, for in giving his welcome to delegates he is the first speaker, and in the highlight of the social events, the Civic Reception, he is of course the host. Councillor H. S. Hitchen, M.A., J.P., the present Mayor of Harrogate, whose message we are pleased to record opposite, is, we are informed, the kind of Mayor who is especially good for conferences. He is by profession a well-known Harrogate bookseller, and is a former President of the Booksellers' Association. He has been a member of the Harrogate Council since 1954 and a Chairman of its

Health Committee. For over thirty years he has been a local preacher in the Methodist Church.

Harrogate and the Society

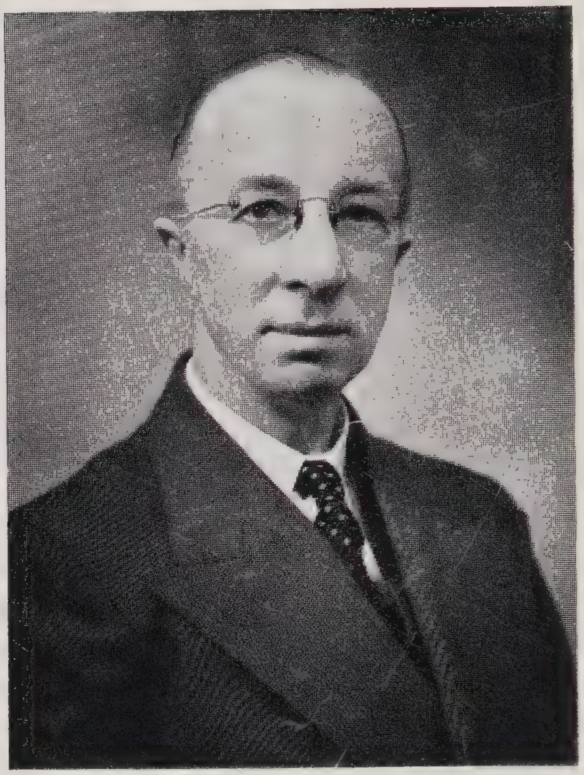
The Society has met in Harrogate more than in any other town, and if we count the 1928 Conference of the Smoke Abatement League of Great Britain, this is the fifth occasion. 1928 saw the last conference of the League, for in the following year it joined forces with the London Coal Smoke Abatement Society to form our present association, then called the National Smoke Abatement Society. The 1928 Conference had an attendance of about 40, and took place in a lounge in one of the hotels. There was no return to Harrogate until after the last war, because it became the rule—until growth made it too difficult—to meet in the bigger and more polluted cities.

The Des Vœux Memorial Lecture

Newcomers to the Conference may ask about the origins of this Lecture, to be read this year (after a break) by Dr. J. S. Carter, the Chief Alkali Inspector. Dr. Harold Des Vœux was probably the most notable, and certainly the most determined, pioneer for clean air in this country. A London physician, he was in effect the founder of the Coal Smoke Abatement Society in 1898, was its driving force and treasurer throughout its existence, and was the president of the later National Smoke Abatement Society from its formation until his death in 1943. Of French and Irish ancestry, he was a vigorous and fearless exponent of the need for clean air, who cared not that he was regarded by many, in the early years, as a crank. The institution of the Lecture in his name was a fitting way of honouring his memory.

The Smoke Control Situation

After the White Paper and the famous Circular 69/63, which rocked the foundations on which domestic smoke prevention was being built, a stocktaking of the situation was recognized by the Conference Committee as one of the most important subjects to be discussed at the present Conference. Reactions among Local Authorities have varied considerably and no better way could have been chosen for reviewing the situation than to invite regional reports through the Society's own Divisions. These will be presented and discussed on Tuesday afternoon and a lively discussion can be anticipated. We are sure that all delegates will recognize the considerable efforts made by the authors in securing their information, and in analyzing and discussing it. Printed together, the reports may seem to be of formidable length, but individually they have differences of approach and comment that make their reading both interesting and illuminating. There are too many for individual presentation, so they will be introduced and surveyed together by Mr. Winfield, who may be relied upon to make a vigorous, perceptive and good-humoured rapporteur.



Dr. Albert Parker, President

The Sulphur Dioxide Report

The final business of the Conference

will be to discuss a report on Sulphur Dioxide, on which the Technical Committee has been working for some months. It is believed that the report is of importance, not because of anything novel it may contain, but because it clearly and methodically analyzes the problem and shows that it is in fact a complex of problems that call for separate consideration and modes of approach. No easy solutions are offered, but it is concluded that the measures needed to prevent smoke are also helping either to reduce sulphur dioxide or are preventing it from becoming worse—as indeed, with the increasing use of energy by the nation it might well do. Because the fullest publicity should be given to the report it may have been issued to the press prior to the Conference.

The Luncheon

The Conference Luncheon at the Cairn Hotel on Thursday, October 22, is an innovation which we hope will be fully supported. The principal guests will be the fuel industries speakers from the morning session—Sir Henry Jones, Mr. C. T. Melling, Mr. E. Rendall, and Mr. Frank Wilkinson—and Dr. Carter, the Chief Alkali Inspector, who will be giving the Des Vœux Memorial Lecture in the afternoon. Any delegate who has not already secured a ticket for this special occasion (25s.) should inquire at the Conference Office in the Exhibition Hall as soon as possible.

Conference Extras

There is no need to repeat information about the events additional to the Conference sessions that are detailed elsewhere. But with the usual preliminary "get-together", theatre shows, visits for delegates' ladies, the civic reception, works visits, a golf tournament, a film show, and of course the Exhibition, there is enough to keep everyone fully occupied from Monday evening until Friday lunch.

The Exhibition will have some new and interesting features and delegates are advised to plan to give adequate time to its inspection, or they may miss much.

To publicize the Exhibition among the general public—which will help the clean air drive in Yorkshire—and in particular help to make the younger generation clean air conscious, a novel competition for schoolchildren has been arranged with the co-operation of ABC Television. This is to submit a television "storyboard"—a sort of illustrated scenario—for a TV "spot" of 45 seconds on the subject of clean air. The winning entries will be displayed in the Exhibition, and there will then be another competition, this time for adults, to place these in order of merit or effectiveness. Remarkably generous prizes have been offered for both competitions by friends and well-wishers of the Society. The prizes will be distributed during the interval at the Theatre Visit on the Thursday evening. Full details of the competition will be found on page 102. Incidentally, it should be made clear that Conference delegates may, if they wish, enter for the *second* competition.

Next Year

The 1965 Conference will be held at Eastbourne from October 26 to 29. The programme is likely to be extended to take in special sessions of international interest, but the time given to home affairs will not be curtailed. Immediately after the present Conference is over the Conference Committee will begin to consider the detailed programme for Eastbourne, and they would of course welcome any suggestions for subjects or speakers from members and delegates.

National Society for Clean Air

Present and Past Officers, etc.

President: Dr. Albert Parker, C.B.E.

Immediate Past-President: The Rt. Hon. Lord Cohen of Birkenhead.

Past-Presidents: Dr. H. A. Des Vœux*, Will Melland*, Sir George Elliston*, Lord Simon of Wythenshawe*, Dame Vera Laughton Mathews, D.B.E.*, Alderman Professor F. E. Tylecote, C.B.E., Sir Ernest Smith, C.B.E.*, Dr. R. Lessing, C.B.E.*, Sir Hugh Beaver, K.B.E. (* *Deceased*).

Hon. Treasurer: Stanley E. Cohen, C.C.

Past Hon. Treasurers: Will Melland, Sir Lawrence Chubb, Sir Ernest Smith.

Chairman of Council: James Goodfellow.

Deputy Chairmen: T. Henry Turner, A. C. Saword.

Immediate Past-Chairman: Dr. J. L. Burn.

Past-Chairmen: Will Melland, Charles Gandy, S. N. Duguid, J.P., Dr. W. R. Martine, O.B.E., T.D., F. J. Redstone, Dr. J. S. G. Burnett, John Innes, M.B.E.

Vice-Presidents: S. N. Duguid, J.P., Alderman Dr. C. A. Bence, Commander Colin Buist, M.V.O., H. G. Clinch, M.B.E., G. W. Farquharson, T. C. Finlayson, C.B.E., Councillor Eric Gibbons, John Innes, M.B.E., Dr. J. Johnstone Jervis, Dr. R. H. H. Jolly, James Law, Alex W. Lee, Dr. W. R. Martine, O.B.E., T.D., Alderman F. W. Perry, J.P.

Chairmen of Committees:

Conference: S. Cayton.

General Purposes and Finance: James Goodfellow.

Parliamentary and Local Government: E. M. Birtwistle.

Publicity: Miss M. George, M.B.E.

Technical: Dr. J. S. G. Burnett.

Standing Counsel: W. R. Hornby Steer.

Hon. Solicitors: Messrs. Bell, Brodrick and Gray.

Hon. Auditors: Messrs. Geo. Little Sebire & Co.

Bankers: The District Bank Ltd.

Divisional Councils: Chairmen and Secretaries

Scottish: Councillor W. Monteith (*President*), John W. Traill.

Northern Ireland: Councillor Miss I. M. McAlery, W. E. C. O'Brien.

North-West: F. Taylor, W. E. Pollitt.

North-East: Alderman B. N. Young, L. Mair.

Yorkshire: A. C. Saword, James Goodfellow.

West Midlands: Councillor F. V. Magness, W. L. Kay.

East Midlands: H. N. Eardley, A. Wade, M.B.E.

South-East: W. Combey, J. S. Hodgins.

South Wales and Monmouthshire: Alderman Dr. C. A. Bence, J. A. Church.

Headquarters Staff:

Director, Secretary and Editor: Arnold Marsh, O.B.E.

Assistant Secretary: Alan A. Mister.

Exhibitions and Advertisement Officer: Roy J. Sharp.

Information Officer and Librarian: Mrs. V. Finlay.

Accountant: Mrs. D. M. Wolfe.

Secretarial Assistants: Mrs. M. H. Mellins, Miss B. Bull, Miss A. Roberts, Miss J. Negus, Miss L. Counsell.

For New Delegates

ABOUT THE SOCIETY

Those who are attending the Conference for the first time may wish to know more about the National Society for Clean Air. As we celebrated our Diamond Jubilee in 1959 with a special International Conference it will be seen that the Society has quite a long history. Starting in a very small way with but a handful of private individuals, the Coal Smoke Abatement Society was formed in 1899. It did valuable pioneering work and accomplished the first necessary stage of making it understood that clean air was not the impractical fad of a few cranks. It did much behind the scenes when the Newton Committee was set up, and co-operated with a provincial association that had been formed in 1909, the Smoke Abatement League of Great Britain. In 1929 the two bodies joined together to form the National Smoke Abatement Society.

This name was retained until 1958, when it was changed to the present one, and at the same time, to put its membership and finances on a recognized business footing, it became a Company Limited by Guarantee and not having a share capital. It is licensed by the Board of Trade to omit the word "Limited" from its name and is registered as a Charity with the Charities Commission. It is similarly recognized by the Board of Inland Revenue for income tax purposes.

The Society is a voluntary organization essentially subsisting on the subscriptions of its members, and it does not receive any official grant or subsidy. Its members include individuals, local authorities and firms, associations and other corporate bodies. Although local authorities—over 500—constitute the largest class of membership the corporate members make the largest class of subscriptions. The Society is governed by an Executive Council consisting partly of elected representatives of members on a divisional basis, and partly of the appointed representatives of national organizations in membership. The Divisions are: Scotland, North-West, North-East, Yorkshire, West Midlands, East Midlands, South-East, South Wales and Monmouthshire, South-West, and Northern Ireland. There are Divisional Councils of members, with their own committees and honorary officers, in each of the Divisions except the South-West.

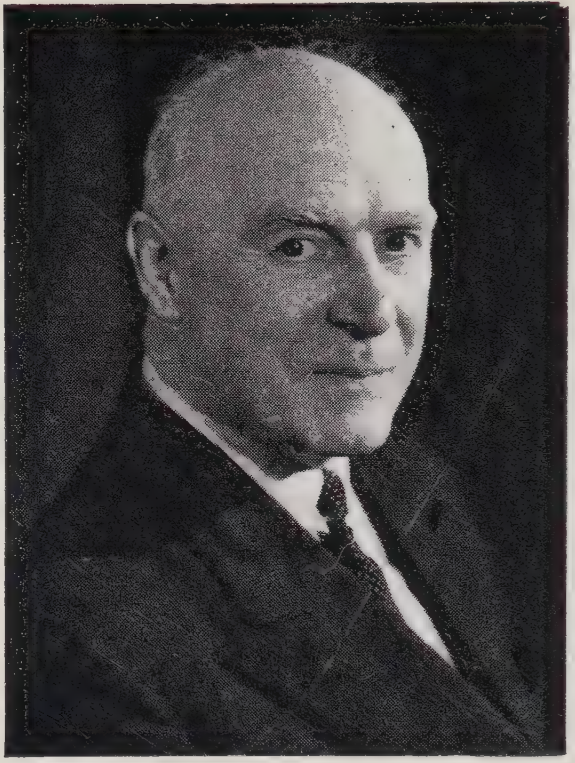
The Society's objects are, in brief, to promote clean air by education, publicity and similar means, to encourage the adoption of means for clean air, and generally to help to create a public opinion in favour of these objects. Its main activities are the publication of a journal, Year Book and other literature, the holding of conferences and meetings, providing educational and publicity material, information and other services, and co-operating with others.

The Society and its parent bodies have many achievements to their credit, from pioneering the training of boilerhouse firemen and the regular measurement of air pollution to the conception and advocacy of smokeless zones and prior approval. More recently the Society has been successfully concerned with the problems of road vehicle pollution.

Today, with the Clean Air Act in force, the opportunities for useful activity by the Society are greater than ever before, and are in fact both needed and demanded more than ever before. But much remains undone because its income is only a tithe of what could be used to advantage. New members, and more new members, are needed—and if you, as a delegate to this conference, can help us to secure them you will be doing a very good turn to the cause of clean air.

Speakers from the Fuel Industries

Sir Henry Jones



C. T. Melling

E. Rendall

F. Wilkinson

Platform Who's Who

Birtwistle, E. M., M.R.S.H., F.A.P.H.I. Chief Public Health Inspector, Horsforth; Chairman, Parliamentary and Local Government Committee, N.S.C.A.

Burnett, J. S. G., M.D., D.P.H. Medical Officer of Health, Preston; Chairman, Technical Committee and Past-Chairman, Executive Council, N.S.C.A.

Carter, J. S., C.B.E., Ph.D., M.Sc., F.R.I.C., M.Inst.F. Chief Inspector of Alkali &c., Works, Ministry of Housing and Local Government.

Cayton, S., F.R.S.H., M.A.P.H.I., M.Inst.F., M.Inst.P.C. Chief Public Health Inspector and Cleansing Superintendent, West Bromwich; Chairman, Conference Committee, N.S.C.A.

Cohen, Stanley E., C.C., F.R.S.H. Honorary Treasurer, N.S.C.A.; Member of the Clean Air Council; Member of the Court of Common Council, City of London.

Cooper, J. A., Ph.D. Project Design and Engineering Department, Agricultural Division, Imperial Chemical Industries Limited, Billingham.

Craxford, S. R., M.A., D.Phil. Head of Atmospheric Pollution Division, Warren Spring Laboratory, D.S.I.R.

Dhenin, G. W. Deputy Chief Public Health Inspector, Bath; Member of the Executive Council, N.S.C.A.

Fawell, H. Denys, A.M.I.Mech.E. Superintending Engineer, Mechanical Engineering, Ministry of Transport.

Goodfellow, James, F.R.S.H., M.A.P.H.I. Chief Public Health Inspector, Leeds; Chairman of Executive Council and Hon. Secretary, Yorkshire Division, N.S.C.A.

Goss, Anthony, A.R.I.B.A., Dip.T.P. (London), A.M.T.P.I. Head of the Leeds School of Town Planning; Author of "British Industry and Town Planning".

Hiller, G. A., F.R.S.H., F.A.P.H.I. Chief Public Health Inspector, Leicester; Member of the Executive Council, N.S.C.A.

Hitchen, Councillor H. S., M.A., J.P. Mayor of Harrogate. (*See page 21.*)

Hodgins, J. S., M.R.S.H., M.A.P.H.I. Chief Public Health Inspector, Hayes and Harlington; Member of the Executive Council and Hon. Secretary, South-East Division, N.S.C.A.

Innes, John, M.B.E. Chief Sanitary Inspector, Paisley; Member, Clean Air Council for Scotland; Past-Chairman, Executive Council and former President, Scottish Division, N.S.C.A.

Jones, Sir Henry, M.B.E. Deputy Chairman of the Gas Council, 1952; Chairman since 1960.

Kay, J., D.P.A.(Lond.), M.A.P.H.I., M.Inst.P.C. Chief Public Health Inspector, Stretford; Member, North-West Divisional Council, N.S.C.A.

Kay, W. L., F.A.P.H.I., M.R.S.H. Chief Public Health Inspector, Smethwick; Member, Executive Council, N.S.C.A.; Hon. Secretary West Midlands Division, N.S.C.A.

Mair, L., F.A.P.H.I., F.R.S.H. Chief Public Health Inspector, Newcastle-upon-Tyne; Member, Executive Council, and Hon. Secretary, North-East Division, N.S.C.A.

Melling, C. T., C.B.E., M.Sc.Tech., M.I.E.E., M.I.Mech.E., F.Inst.F. Deputy Chairman, Electricity Council; Member of the Clean Air Council.

Page, J. K., B.A. Professor of Building Science, University of Sheffield; Chairman, Engineering Group, International Society of Biometeorology.

Parker, Dr. Albert, C.B.E., D.Sc., M.Inst.Chem.E., M.Inst.Gas.E., F.R.S.H. President of the Society; Former Director, Fuel Research Station, D.S.I.R.; Executive Vice-President, Royal Society of Health; Hon. Secretary, British National Committee, World Power Conference.

Reed, L. E., Ph.D., A.M.I.Mech.E. Warren Spring Laboratory, D.S.I.R.

Rendall, E., M.Inst.F., M.Inst.Pet. General Manager, Industrial Sales, Shell-Mex and B.P. Ltd.

Saword, A. C., D.P.A., F.R.S.H., F.A.P.H.I. Chief Public Health Inspector, Kingston-upon-Hull; Joint Deputy Chairman, Executive Council, and Chairman, Yorkshire Division, N.S.C.A.

Sherfield, The Rt. Hon. Lord. (*See page 21*).

Turner, T. Henry, M.Sc., M.I.Mech.E., M.I.Loco.Eng., F.I.M. Individual Member; Joint Deputy Chairman, Executive Council, N.S.C.A.

Weatherley, Mrs. M.-L. P.M., M.A. Warren Spring Laboratory, D.S.I.R.; Engaged on the study of the distribution of pollution within towns and a joint survey of pollution with the Department of Geography, University of Sheffield.

Wilkinson, Frank. Marketing Member, National Coal Board; President, Coal Utilisation Council; Member of the Domestic and Industrial Coal Consumers' Councils and the Solid Smokeless Fuels Federation.

Winfield, E. J., C.R.S.H., F.A.P.H.I., M.Inst.P.C. Senior Public Health Inspector, Castleford; Member, Executive Council, N.S.C.A.

Previous Conferences of the Society

1929	Buxton
1930	Leicester
1931	Liverpool
1932	Newcastle upon Tyne
1933	Sheffield
1934	Glasgow
1935	Bristol
1936	London (Science Museum)
1937	Leeds
1938	Cardiff
1943	London*
1945	London*
1946	Brighton*
1947	Edinburgh
1948	Cheltenham*
1949	Harrogate*
1950	Margate*
1951	Blackpool
1952	Portsmouth*
1953	Glasgow*
1954	Scarborough*
1955	Bournemouth
1956	Southport*
1957	Hastings*
1958	Llandudno*
1959	London (Diamond Jubilee International)*
1960	Harrogate*
1961	Brighton*
1962	Harrogate*
1963	Scarborough*

** Proceedings still available. For prices and other details see current Clean Air Year Book.*

Conference Information

Meeting Place

All Conference sessions and the "get-together" of members and delegates will be held in the Royal Hall.

Registration

A Registration Card will be enclosed with this Handbook, and you are requested to complete this and hand it in at the Society's Information Desk, at the first session attended.

Discussions

Those wishing to speak in the discussions should complete and hand in a printed Discussion Card which may be obtained from the Information Desk or Steward in the hall. All speakers are requested to: (*a*) condense their remarks as much as possible, and (*b*) confine them to the specific questions raised in the papers being discussed. The time allowed for contributions will normally be limited to three minutes. Those who take part in the discussions and wish to have their remarks recorded are asked to send a condensed copy of their remarks, in reported speech, to the Director not later than October 30.

Resolutions

The following conditions for the submission of resolution are stipulated by the Executive Council:

(*a*) Any resolution it is desired to submit must be relevant to matters under discussion at the conference.

(*b*) No resolution may be moved except by prior approval of the Resolutions Committee.

(*c*) A copy of the proposed resolution must be received by the Director not later than 10.30 a.m. on Wednesday, October 21, or preferably by post (at the Society's offices) on or before Friday, October 16.

(*d*) Resolutions will be moved at the end of the Friday morning session only.

List of Delegates

A printed list of delegates will be available in the Conference Office in the Exhibition Hall.

Proceedings

All the Papers, Addresses, discussions and any resolutions adopted will be published in volume form as the *Proceedings* of the Conference. A copy will be forwarded free of charge to all registered delegates and extra copies will be available at about 25s. each.

Bookstall

The Society's, H.M.S.O., and other publications will be displayed on a bookstand in the South Corridor, Royal Hall. They will also be displayed in, and may be purchased from, the Conference Office.

Conference Office

The Society's Conference Office will be in the Exhibition Hall, where members of the Staff will be pleased to answer inquiries. The accountant will be at the office for the receipt of fees and other payments. There will also be an Information Desk in the South Corridor of the Royal Hall.

The Exhibition

The National Clean Air, Fuel Efficiency and Domestic Heating Exhibition—the seventh to be organized by the Society in conjunction with its annual conference—will be in the Exhibition Hall.

All delegates should make a point of visiting the exhibition. For hours of opening see page 37. Particular attention is drawn to the Society's own exhibits which will include the latest publicity aids available to local authorities and all concerned with the promotion of clean air. All exhibition inquiries, including information about the Eighth Exhibition at Eastbourne should be addressed to the Exhibition Organizer, Roy J. Sharp.

Visits and Tours

Details of works visits and tours, etc., for delegates' ladies have been sent to delegates. Any further information about the arrangements will be announced or displayed at the conference and will be available at the Conference Office. Inquiries should be made to the Assistant Secretary, Alan A. Mister.

Golf Tournament

A golf tournament will be held on the afternoon of October 21 at the Pannal Course. Tee-off will be at 1 p.m. A trophy is being presented by the Solid Smokeless Fuels Federation for annual competition at the Conference. In addition the S.S.F.F. will present the yearly holder with a suitably inscribed tankard.

Conference Club

Registration as a delegate includes membership of the Conference Club, at the rear of the Royal Hall. A membership ticket, which will be required for admission, will be enclosed with this Handbook to delegates. Light refreshments and drinks will be available throughout the day in the Exhibition.

Postal Facilities

A G.P.O. self-service post office will be located in the South Corridor of the Royal Hall.

Bank Facilities

Full banking facilities will be available to all attending the Conference or Exhibition from the District Bank Ltd., at Stand A.11 in the Exhibition Hall.

Rail Travel

There will be a British Railways Inquiry Bureau in the Exhibition Hall, Stand C.13, where information about rail travel, seat reservations, etc., may be made.

Inquiries relating to reduced fare rail tickets should be addressed to:

Thos. Cook and Son Ltd.,
123 High Holborn,
London, W.C.1. (HOLborn 3281).

Photography

The official photographer is Mr. Paul Dong, who will be solely responsible for all photographs of the exhibition, conference and other events. He will have an office and darkroom in the Royal Hall and will provide a 24-hour service. Delegates and visitors are advised not to give orders for photographs to any unauthorized photographer or agent.

General Inquiries

The Society's staff at the Conference Office and Information Desk will be pleased to assist with any inquiries on matters not mentioned above.

Programme
of the
Conference

MEETING PLACES

All Conference Sessions, the Informal Gathering, Civic Reception and Film Show in the Royal Hall. The Conference Luncheon in the Cairn Hotel.

For details of Authors, Speakers, etc., see "Platform Who's Who", page 27.

Monday, October 19
Evening

From 8.30 Informal Gathering.

Tuesday, October 20
Morning

10.00 Opening Session.
Chairman: The President, Dr. Albert Parker, C.B.E.
Civic Welcome by the Worshipful the Mayor of Harrogate, Councillor H. S. Hitchen, M.A., J.P.
Address and Opening of the Conference by the Rt. Hon. Lord Sherfield.
The Presidential Address.

11.30 Conclusion of Session. The Principals in the Platform Party will proceed to the Exhibition, which will be formally opened by Lord Sherfield.

Afternoon

Chairman: James Goodfellow

2.30 Smoke Control Areas: Reports from Divisions.

Scotland: John Innes, M.B.E.
North-West: J. Kay
North-East: L. Mair
Yorkshire: A. C. Saword
West Midlands: W. L. Kay
East Midlands: G. A. Hiller
South-West: G. W. Dhenin
South-East: J. S. Hodgins
Discussion Opener: E. J. Winfield

4.30 approx. Close of Session.

6.00 Exhibition closes.

Evening

8.30 Civic Reception (*by invitation*).

Wednesday, October 21

Morning

9.30 Exhibition opens.

Chairman: Stanley E. Cohen, C.C.

10.00 Town Planning and Air Pollution.
Papers by (1) Professor J. K. Page,
and (2) Dr. S. R. Craxford and Mrs. M-L P. M. Weatherley.
Discussion Opener: A. Goss.

12.30 approx. Lunch adjournment.

Afternoon

2.30 Film Session—see page 35 for programme.

4.15 Close of Film Session.

Evening

8.00 An Evening with David Kossoff—Royal Hall (Tickets from the Box Office).

9.30 Exhibition closes.

Thursday, October 22

Morning

9.30 Exhibition opens.

Chairman: Dr. Albert Parker, C.B.E.

10.00 Smokeless Fuels—"The Future Supply Position".
Addresses by:

Gas: Sir Henry Jones, M.B.E.
Solid Fuel: F. Wilkinson.
Electricity: C. T. Melling, C.B.E.
Oil: E. Rendall.

Discussion Opener: E. M. Birtwisle.

12.15 approx. Lunch adjournment.

12.30 for **12.45** Conference Luncheon—Cairn Hotel.

Afternoon

Chairman: T. Henry Turner

2.30 Des Vœux Memorial Lecture.
"A Century of Achievement" by Dr. J. S. Carter, C.B.E.
Discussion Opener: Dr. J. A. Cooper.

4.30 approx. Close of Session.

6.00 Exhibition closes.

Evening

8.00 Theatre Visit—Opera House, Oxford Street. (see page 35).

Friday, October 23

Morning

9.30 Exhibition opens.

Chairman: S. Cayton

10.00 (1) Road Vehicle Pollution: Black Smoke—Some Causes and Possible Methods of Control, by H. D. Fawell.

(2) Sulphur Dioxide: Report by the Society's Technical Committee, presented by Dr. J. S. G. Burnett.

Discussion Opener: Dr. L. E. Reed.

12.15 Any resolutions; General vote of thanks, etc.

12.30 Close of Conference and Exhibition.

The Pump Room, Harrogate, 1829

THE FILM SHOW PROGRAMME

The Film Show on Wednesday, October 21, will be held in the Royal Hall, at 2.30 p.m. All the films are 16 mm. sound prints.

(1) IT TAKES YOUR BREATH AWAY

A new British film having its premier at Harrogate. The Society's Office in London was used for the first production conference and the Society has supplied material and information. Produced by Kenneth W. Fensom and a team of students taking a course on film production at the Regent Street Polytechnic, London. (*10 minutes*)

(2) THE CITY—CARS OR PEOPLE

One of a series of five films made by the National Film Board of Canada dealing with those trends in modern civilization that threaten City life. Introduced by Lewis Mumford, the opening sequence of the film shows the dirt and squalor that existed until very recently in areas adjacent to railway tracks. The viewer is then asked to confront the threat to city amenities posed by the privately-owned motor car. This film was recently awarded a 1st place in the United States Film Festival, New York. (*28 minutes*)

(3) VOLCANIC POWER

The story of the harnessing of geothermal power in New Zealand. This New Zealand National Film Unit colour film conveys the extent of the engineering achievement, credit for which can be shared by both British and New Zealand engineers. Harnessing steam in Wairakei has focused attention on the risks arising from gases, mainly hydrogen sulphide, dissolved in geothermal water in the region. (*24 minutes*)

(4) TAKE A DEEP BREATH

Described as "a hard-hitting documentary treatment of the air pollution problems in one of America's largest cities" by the U.S. Public Health Service, this film emphasizes the health effects of air pollution.

Produced by WCAU-TV, Philadelphia, it includes interviews with Dr. Katherine Boucot, a Respiratory Disease Specialist, and the former Air Pollution Control Officer of Philadelphia.

The need for strong public support of control efforts, which the film stresses, is pertinent to this country. (*25 minutes*)

(5) THE FACE OF THE COUNTRY

This new Czechoslovakian air pollution film deals with aspects of flue ash problems. No other details available at time of going to press.

Theatre Visit

The play, to be given by the White Rose Theatre Company at the Opera House on Thursday evening will be "Grand National Night", a thriller by Dorothy and Campbell Christie. Reserved seats 6s. each from the Conference Office.

During the interval prizes in the TV Storyboard Competition (see pages 102 and 103) will be presented by A.B.C. Television announcer, Miss Sheila Kennedy.

Book these dates

26th - 29th OCTOBER, 1965
EASTBOURNE

THE 32nd ANNUAL CONFERENCE

of the National Society for Clean Air
and the Eighth National

CLEAN AIR,
FUEL EFFICIENCY and
DOMESTIC HEATING
EXHIBITION

Exhibition plan now available in the Organizer's office

* * *

4th—7th OCTOBER, 1966
GREAT YARMOUTH

The 33rd ANNUAL
CONFERENCE AND EXHIBITION

* * *

Details from the Exhibitions Officer, National Society for Clean Air, Field House, Breams Buildings, London, E.C.4.
Telephone: CHAncery 5038

SEVENTH NATIONAL
CLEAN AIR
FUEL EFFICIENCY AND
DOMESTIC HEATING
EXHIBITION

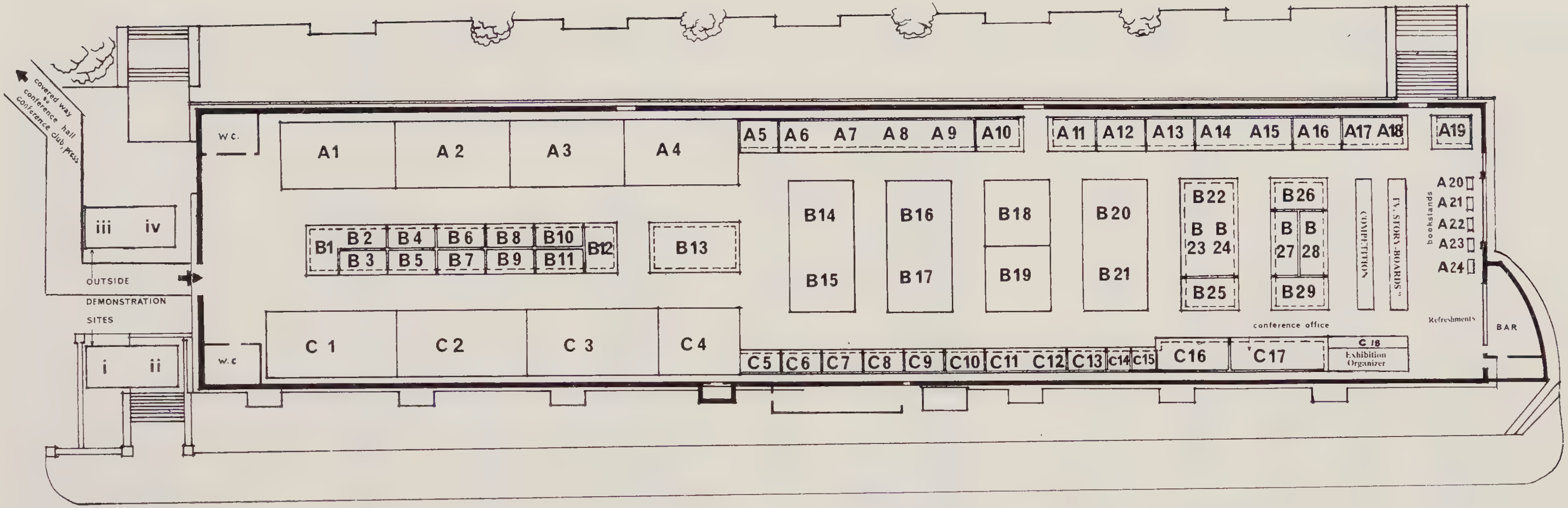
CATALOGUE

EXHIBITION HALL,
HARROGATE,
YORKSHIRE

20th—23rd OCTOBER, 1964

Hours of opening:

Tuesday, 20th October — 11.30 a.m. to 6.00 p.m.
Wednesday, 21st October — 9.30 a.m. to 9.30 p.m.
Thursday, 22nd October — 9.30 a.m. to 6.00 p.m.
Friday, 23rd October — 9.30 a.m. to 12.30 p.m.



EXHIBITION PLAN AND KEY TO STANDS

Stand No.	Exhibitor
A1	National Carbonising Co. Ltd.
A2	Electrical Development Association
A3	Shell-Mex and B.P. Ltd.
A4	B.S.A. Harford Pumps Ltd.
A5	Thermotank Ltd.
A6-9	Coal Utilisation Council
A10	Women's Advisory Council on Solid Fuel
A11	District Bank Ltd.
A12	Elliott-Automation Ltd.
A13	Powell Duffryn Heating Ltd.
A14-15	Baxi
A16	Thermodare (Great Britain)
A17-18	Potez Industries of Ireland Ltd.
A19	Bibby Fires Ltd.
A20	Municipal Journal
A21	Butterworth & Co. (Publishers) Ltd.
A22	Local Government Chronicle
A23	Pyramid Press Ltd.
A24	Calor Gas (Distributing) Co. Ltd.
B1-2	Cannon Industries Ltd.
B3	F. E. Beaumont Ltd.
B4	Hodgkinson Bennis Ltd.
B5 and Outside Sites I and II	Universal Machinery & Services Ltd.
Outside Sites III and IV	Allied Ironfounders Ltd.
B6	Storeheat (Electrical) Ltd.
B7	Bibbey Ltd.
B8	Sager Ltd.
B9	Lectromatic Heating Systems Ltd.
B12	Oil Appliance Manufacturers' Association
B13	Radiation Parkray Ltd.
B14-15	The Gas Council
B16-17	Ministry of Housing & Local Government
B18	Department of Scientific & Industrial Research
B19	British Iron & Steel Federation
B20-21	Central Electricity Generating Board
B22, 23, 24	Collectron Ltd.
B25	Lonor Ltd.
B26	Allied Ironfounders Ltd.
B27	Robophone Ltd.
B28	"Select the Best Ten TV Story-boards" Competition
B29	Airwick Ltd.
C1	Coalite & Chemical Products Ltd.
C2	Solid Smokeless Fuels Federation
C3	National Coal Board
C4	Glow-Worm Boilers Ltd.
C5	West Riding Clean Air Advisory Council
C6	Kavag (W. Germany)
C7	Tilghman's Ltd.
C8	Barnsley District Coking Co. Ltd.
C9	Morfitt & Son
C10	Paul Dong
C11-12	National Society for Clean Air
C13	British Railways
C14	A. Bell & Co. Ltd.
C15	Saniguard Appliances Ltd.
C16	Lucas Industrial Equipment Ltd.
C17, 18	Conference Office and Reception Lounge

Next to entrance: (a) Kay Bros. Ltd. (b) British Standards Institution

EXHIBITORS AND DESCRIPTION OF EXHIBITS

The information given in this list has been supplied by the Exhibitors and no responsibility for any of the statements or descriptions can be accepted by the National Society for Clean Air.

Stand No.

B29 AIRWICK LIMITED, Slough, Bucks. (Telephone: Slough 22322).

Airwick Limited, well-known leaders in the field of odour-counteraction and air-freshening methods, are displaying up-to-date examples of their equipment, odour destroying and air-freshening formulations, which today are virtually everywhere in use.

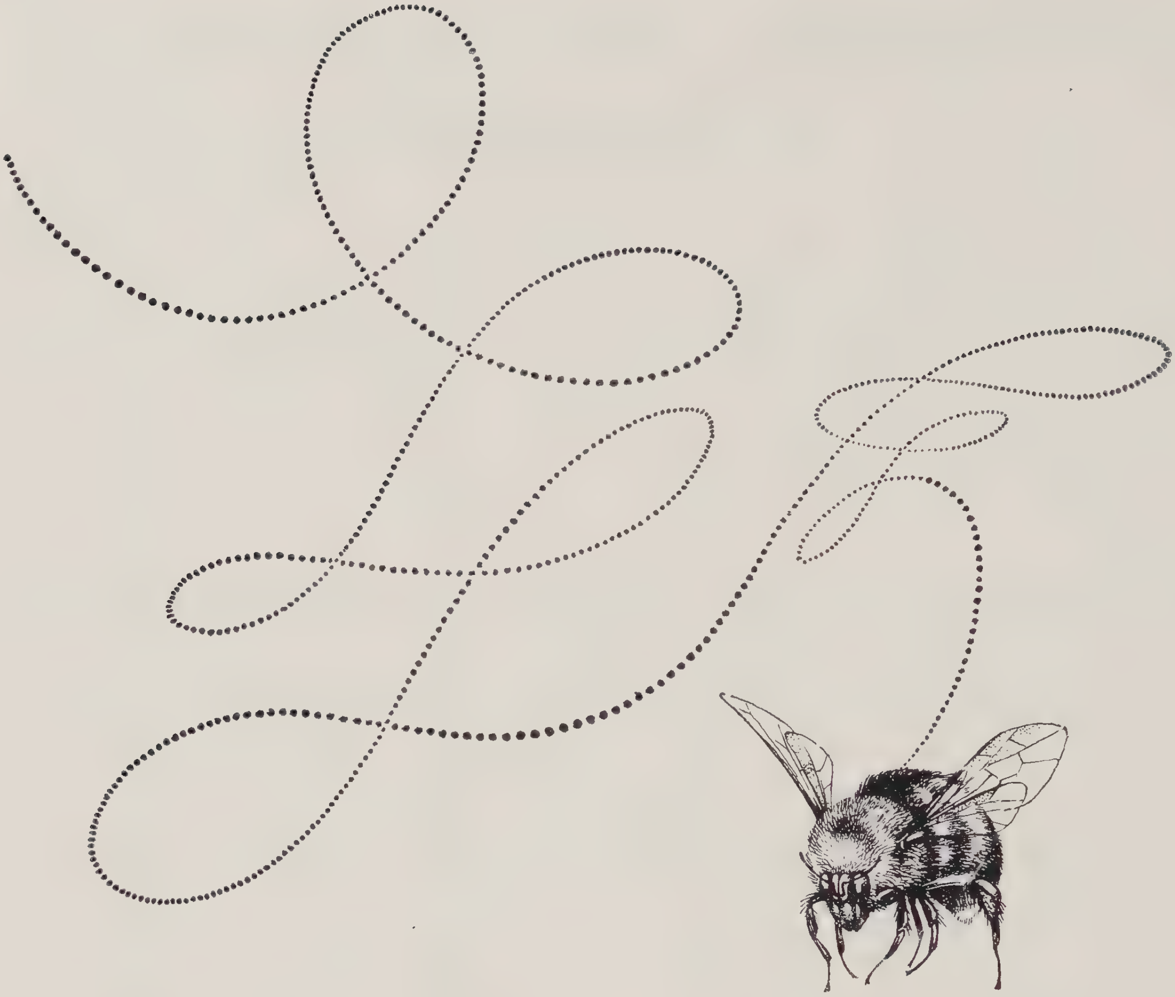
Architects and air-conditioning specialists will be able to see such units as THE SENTINEL, designed to be installed into the ducting of ventilation systems, without altering the duct work or power units in any way.

Everybody, professional and public, will be able to see the Airwick "CAVALIER II", and the "OSMEFAN"—appliances not much larger than portable radios—which are proving most successful in homes, institutions, factories, offices and hospitals, for the counteraction of odour and air-freshening. The Cavalier may be used anywhere there is a bad or stale air problem in a space of up to 10,000 cu. ft., while the Osmefan may be used for the same purpose but for larger areas and more permanent installations than the Cavalier. In connection with these units, visitors to the Stand will be interested in the choice of formulations with which they are now supplied for different odours and odour-level applications.

Members of local authorities, public health inspectors, medical officers of health, will be able to obtain first-hand information on the proved methods by which Airwick are being so successful in combating the malodourous air emanating from sewage plants and factories in many industries.

The Airwick method of odour-counteraction and air-freshening is not to mask an unpleasant smell or cover up one with another. Instead, carefully balanced formulations made up from over 125 natural compounds are released into the atmosphere where they "pair" with unpleasant smells and neutralize them completely.

Technical representatives on the Airwick stand will be pleased to supply visitors with more detailed information and discuss specific problems.



clean air flows from the Allied Ironfounders caravan

Come inside and see how efficiently economical, low priced and good looking smokeless fuel warmth makers can be when they're made by ALLIED IRONFOUNDERS. AGA boilers, RAYBURN PRINCESS room heaters, DALE, SOFONO, and LOWBURN fires, AGAVECTOR warm air units, ALLIED radiators — they're all on show inside.

If you want unbiased advice
on which appliance to install
—see the Allied Ironfounders
Stand No. B. 26.
And outside site iii and iv.

CLEAN AIR APPLIANCES BY ALLIED IRONFOUNDERS

ALLIED IRONFOUNDERS LTD · DOMESTIC APPLIANCE DIVISION
CADBURY ROAD · SUNBURY-ON-THAMES · MIDDLESEX

AI

Stand No.

B26 and outside Demonstration Sites **ALLIED IRONFOUNDERS LTD, 28 Brook Street, London, W.1. (Telephone: GROsvenor 8941). Domestic Appliance Division, Cadbury Road, Sunbury-on-Thames, Middlesex. (Telephone: Sunbury 5577).**

A revolutionary domestic heating appliance will be on show for the first time on Allied Ironfounder's stand. Produced as a result of lengthy research it will represent a new departure in central heating.

To be installed in houses built by traditional or industrialized methods the appliance incorporates many well known features of the Aga boiler together with a lot of new ones.

A wide variety of items manufactured by Allied Ironfounders Ltd. will be on display in the special exhibition caravan outside the exhibition hall.

A large number of heating appliances suitable for smokeless zones will be on display from the "Aga" SF 12 Solid Fuel Boiler to "Sofono" Electric goods.

The SF 12 heats 25 to 40 gallons of hot water although it is only 22½ inches high and 16¼ inches wide.

The "Rayburn Princess" Standard Boiler Model and open fires such as the "Lexham", the "Lowburn" drop fire and the "Rural Mark III" underfloor draft fire will be amongst other heating appliances on display.

A feature of the display devoted to heating is the "Rayburn Princess" under fire serving an Allied radiator in the caravan bathroom and also an "Agavector Junior" in the kitchen.

Steel kitchen units combining hygiene and elegance are also on display; they are Leisure Line, distinguished by sensible design and easy to clean work surfaces.

C8 **THE BARNSLEY DISTRICT COKING COMPANY LIMITED OF WORSBROUGH, near Barnsley. (Telephone: Barnsley 2264).**

"Barnsley BurnBrite" is the new, independently produced, household smokeless fuel for use in approved open fires or in closed appliances. It is manufactured in high temperature ovens which gives it the qualities of high heat output and slow burning or in other words "Heat with Economy".

The price of this fuel, which is a premium fuel, compares well with that of similar products, but economy is achieved through the slow burning rate and the high heat output, and will assist the budget of many a housewife.

The Barnsley District Coking Company Limited take this opportunity of presenting "Barnsley BurnBrite" to the general public for the first time by displaying it on a stand at this Exhibition.

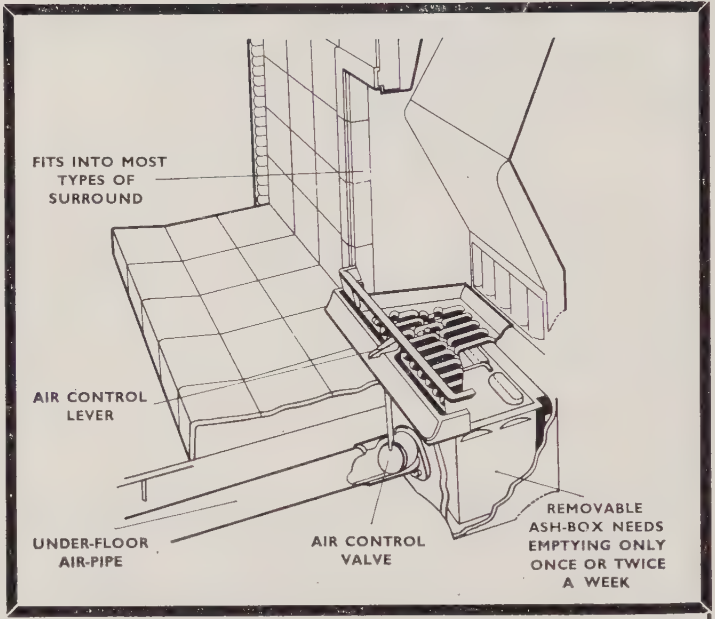
The stand is a very simple representation of part of an office with a "BurnBrite" fire burning in the hearth. The mantlepiece and

(*Entry continued overleaf*)

BAXI
PATENT
UNDER-FLOOR DRAUGHT
FIRE

BAXI, THE UNDER-FLOOR DRAUGHT FIRE, IS THE REAL ANSWER TO YOUR DISTRICT'S CLEAN AIR PROBLEMS

- Baxi guarantee that their under-floor draught fires will burn Sunbrite and all other domestic smokeless fuels when fitted according to their instructions.
- All Baxi fires and boilers are approved for Smokeless Zones by the Domestic Appliances Council on behalf of the Minister of Power.
- Baxi are the originators of the under-floor draught fire and are the undisputed leaders in this field, with over half-a-million satisfied users.
- Free advice and consultation on all technical matters are available from the Special Technical Service Department dealing with Smokeless Zones.
- Baxi under-floor draught fire comes in 16 models and sizes to suit every installation. Most are available if desired with Domestic Output Boiler or with Radiator Output Boiler to give radiator heating as well as domestic hot water—all from the open fire. (Without domestic hot water, 112 sq. ft. of radiators including pipes can be heated at a burning rate of only 2½ lb. of fuel per hour.)


FITS INTO MOST TYPES OF SURROUND
AIR CONTROL LEVER
UNDER-FLOOR AIR-PIPE
AIR CONTROL VALVE
REMOVABLE ASH-BOX NEEDS EMPTYING ONLY ONCE OR TWICE A WEEK

Baxi fires are the answer to Smokeless Zones—at a price your Council and ratepayers *can afford!*
Retail price from £11 12s. 6d.

Full details from Dept. FCA/2

BAXI · BAMBER BRIDGE · PRESTON · LANCS

Telephone: PRESTON 85271

See Baxi on display on Stand No. A 14/15 at the National Clean Air Exhibition, Harrogate.

Stand No.

fire unit were kindly supplied by Builders Materials (Barnsley) Ltd. of 13 Eastgate, Barnsley and of Chapel House, Aldwark, York. Representatives will staff the stand to answer any questions on the fuel or its areas of distribution.

This Company has hitherto played no direct part in publicly supporting Clean Air. Behind the scenes it has provided a valuable service by producing a very excellent quality of Sunbrite, in competition with the National Coal Board, for consumption by the general public in domestic heating appliances and also for smokeless industrial heating.

A14 to A15 **BAXI, Bamber Bridge, Preston, Lancashire. (Telephone: Preston 85271).**

The maximum of comfort with the minimum of work—that is the object of all Baxi Home Heating Products. On their stand, Baxi will have on show the various models of the Baxi Patent Underfloor Draught Fire. This famous fire has won fame in nearly a million British homes already, and in this age of awareness of better and improved heating standards, more people than ever are choosing the highly efficient Baxi Underfloor Draught Fire.

The efficiency of the Baxi Fire is conclusively demonstrated by a working display of BAXI OPEN FIRE CENTRAL HEATING. The latest Baxi Radiator Output Boilers are capable of heating 70 sq. ft. of radiator surface and domestic hot water, or where domestic hot water is heated from another source, 95 sq. ft. of radiator surface. This means that 5 or 6 good size radiators can be used, giving full or background central heating throughout a 2, 3 or 4 bedroomed house. These systems are designed to run on a fuel consumption of only 2½ lbs. of fuel per hour.

All the Baxi appliances on view are approved by the Domestic Solid Fuel Appliances Approval Council and all are suitable for use in smokeless zones.

B3 **F. E. BEAUMONT LTD., 475-493 Rathgar Road, London, S.W.9. (Telephone: BRIxton 4066. Telex: 25837 (Beaumont London). Telegrams: Beaustacks London Telex).**

Apart from general items of interest depicting the equipment used in the erection and maintenance of steel and brick chimneys, F. E. Beaumont Ltd. are exhibiting a 16 ft. high BEAUVENT steel chimney fitted with BEAUVAL aluminium insulating cladding.

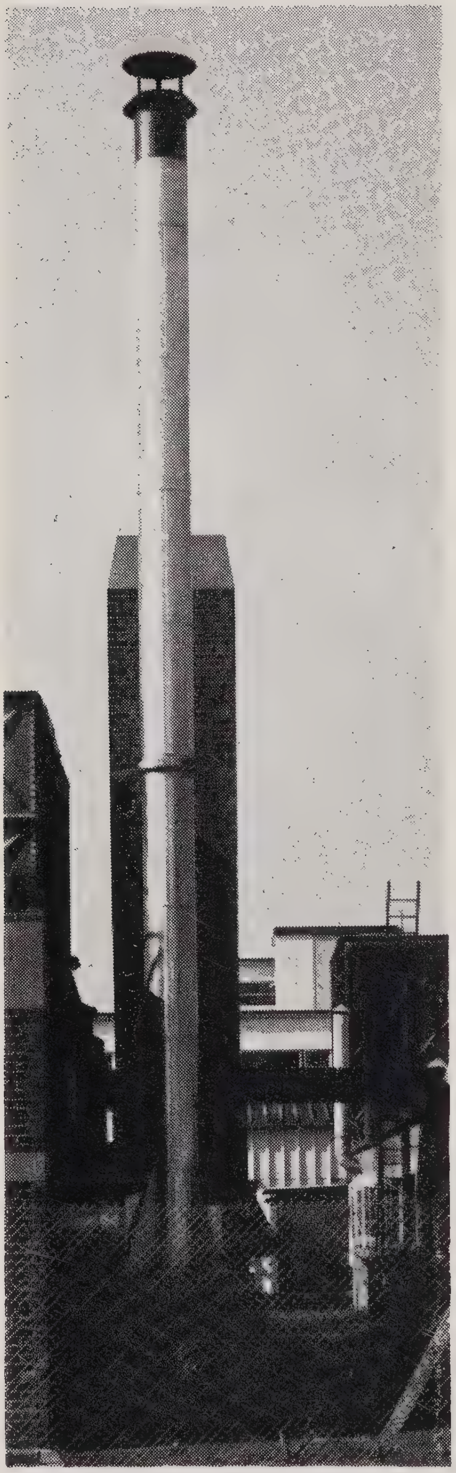
F. E. Beaumont Ltd. are exhibiting a model of a concrete structure carrying three BEAUVENT mild steel chimneys serving

(*Entry continued overleaf*)

F. E. BEAUMONT LTD.

465/483 RATHGAR ROAD · LONDON · S.W.9

BRIxton 4066 Telex 25837



(* Registered Trade Marks)

Manufacturers and Erectors of

***BEAUVENT STANDARD STEEL CHIMNEYS**

In $\frac{1}{4}$ in. m.s. plate varying in diameter from 12 in. to 60 in. in 3 in. increments and from 20 ft. to 100 ft. in height, in 5 ft. increments, cover the requirements of all types of boilers within this diameter range

***BEAUVENT STANDARD STEEL CHIMNEYS**

can be fitted with ***BEAUVAL ALUMINIUM INSULATING CLADDING** to solve corrosion and smut emission problems

---

See us on Stand No. B.3

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*Photograph of a 35 ft. high by 1 ft. 6 in. dia. *Beauvent Standard Steel Chimney fitted with a *Beauval Aluminium Insulating Cladding at the Central Laboratories of the Shell International Petroleum Co. Ltd., at Egham, Surrey* four 35,000 lb. per hour and one 14,000 lb. per hour Richardson Westgarth boilers.

One chimney being 200 ft. high from ground level by 2 ft. 4 in. i.d. and two chimneys 200 ft. high from ground level by 5 ft. 5 in. i.d.

The three chimneys and flues back to the boilers are to be fitted with BEAUVAL aluminium insulating cladding after erection at the University of York.

Standard BEAUVENT chimneys are manufactured on a production line basis, unique in the industry, and are at present equipped to manufacture from $\frac{1}{4}$ in. thick M.S. Plate varying in diameter from 12 in. to 60 in. in 3 inch increments, and in height from 20 ft. to 100 ft. in 5 ft. increments. A total of 259 BEAUVENT standard chimneys which more than adequately cover the requirements of all types of boilers within this diameter range.

F. E. Beaumont Ltd. also design, manufacture and erect individual chimneys to customer's requirements.

C14 A. BELL & CO. LTD., Kingsthorpe, Northampton. (Telephone: Northampton 37501).

A. Bell & Co. Ltd. will be exhibiting one of their 18 in. "Supaheat" 4D Smokeless Zone underfloor draught fires fitted into a Bell "Hole-in-the-Wall" Fireplace. The advantage of this particular fireplace is that it is of integral construction complete with concrete lintel and therefore easily fixed.

The "Supaheat" 4D Fire will also be shown in free standing form fitted with one of the officially approved High Output Backboilers.

B7 A. H. BIBBEY (SALES) LTD., High Wych, Sawbridgeworth, Hertfordshire. (Telephone: Sawbridgeworth 2050/3406).

A. H. Bibbey (Sales) Ltd., sole distributors of the Swedish Husqvarna range of oil-fired warm air heaters are exhibiting three of their units on their stand. The Two-Way Warm Wind unit which provides excellent central heating temperatures in the majority of new houses up to 1,100 sq. ft. super, is normally fitted in a brick chamber in the centre of the house. Warm air is diffused from grilles to all parts of the building. Cost including all necessary fittings, 250-gallon oil tank and primatic domestic hot water cylinder £118 18s. 6d. net (installation extra).

The Husqvarna 44AW Air/Water heater is a comparable unit which can be installed in existing houses where a suitable flue is available. Complete in an attractively designed case it can provide ample heating and hot water for the smaller home. Price not including installation, £95 15s. 3d. nett.

(*Entry continued overleaf*)

Steel invests in cleaner air

ON STAND B.19 you will see some of the many new and interesting measures Britain's Steel Industry has taken to meet the provisions of the Clean Air and Alkali Acts . . . Major investments have been made in gas cleaning plant to bring smoke and dust emissions up to modern standards.

Stand B.19

Seventh National Clean Air, Fuel Efficiency
and Domestic Heating Exhibition

BRITISH IRON AND STEEL FEDERATION
Steel House Tothill Street London SW1

BSS21

The Husqvarna 4002T Air heater provides a simple and effective means of heating a 3-bedroomed semi-detached house for a low figure. Installation can take less than 24 hours with practically no disturbance and cost around £100–£120, dependent on site condition. Running costs for all the above equipment are very economical and compare favourably with all other forms of fuel.

Recommended Fuel—B.P. DOMESTICOL.

A19 BIBBY FIRES LTD., 90 Edgbaston Rd., Smethwick, Staffordshire.

The Bibby fire incorporating a unique patented pre-heat arrangement, is the newest, most economical development in underfloor controlled draught heating, giving high efficiency together with the traditional warmth and comfort of the glow of an open fire.

B19 BRITISH IRON AND STEEL FEDERATION, Steel House, Tothill Street, London, S.W.1. (Telephone: WHItehall 1030).

Air pollution problems in the steel industry are divided quite clearly into two parts. Firstly, those involving grit, dust and smoke emissions from boilers and reheating furnaces, etc., which require compliance with the 1956 Clean Air Act. Secondly, those involving special technical difficulties, such as sinter strands and steelmaking plants which are subject to the requirements of the Chief Alkali Inspector under the 1906 Alkali Act and subsequent extensions.

In many instances compliance with the Clean Air Act has gone hand in hand with technological advancement. In efforts to increase fuel efficiency, coal firing has frequently been replaced by electrical heating or oil firing. Similarly, steam-driven rolling mills, locomotives and cranes are now powered by electrical or diesel equipment. In other cases, gas cleaning plant has been installed to meet the requirements of this Act.

But it is in connection with the processes scheduled under the Alkali Act that the greatest efforts have been required. As part of its "good neighbours" policy, the steel industry has striven to minimize noxious and offensive emissions from these processes. For example, in the new oxy-steel making processes, in the more conventional open hearth furnaces and in the "dressing" of steel surfaces prior to rolling (scarfing), the use of oxygen produces large quantities of very fine red-brown iron oxide fume. To clean these emissions to the standard required, the installation of high-efficiency gas cleaning plant, such as electrical precipitators, bag filters or high-energy wet washers, is necessary. This equipment can be both complex and costly. Some indication of what this has involved is shown in the Federation's display.

Although most of the technical problems have been solved in principle, there are still several practical difficulties hindering continuous and efficient operation of these installations. Two examples are corrosion, a major problem in some types of cleaning plant, and the handling and final disposal of the dust collected.

WHERE'S THE WARMEST SPOT IN THE EXHIBITION? THE B.S.A. HARFORD STAND THAT'S WHERE

JUST LOOKING AT B.S.A. HARFORD OIL-FIRED CENTRAL HEATING EQUIPMENT GIVES YOU IDEAS. IT'S THE CLEANEST, MOST EFFICIENT, WARMEST EQUIPMENT THERE IS. AND THE NICEST LOOKING.

HOW TO FIND THE B.S.A. HARFORD STAND? IT'S No. A4. YOU'LL KNOW IT, BY THE WARM WELCOME YOU FIND THERE.

BSA

HARFORD

BELIEVE IN WARM HOUSES

Stand No.

C13 **BRITISH RAILWAYS (NORTH EASTERN REGION), Public Relations and Publicity Office, York. (Telephone York 53022)**

A British Railways Representative will be in attendance on this stand throughout the opening day, between 12 noon and 1.15 p.m., on Wednesday and Thursday, and 9.30 a.m.-12.30 p.m., and on the last day. Information regarding train times and connections will be available for delegates and visitors for their return journeys.

(b) inside entrance **BRITISH STANDARDS INSTITUTION, British Standards House, 2 Park Street, London, W.1. (Telephone: MAYfair 9000).**

The Institution's exhibit consists of a display of building standards and codes of practice related to the theme of the exhibition with details of how advantage may be taken of the work of B.S.I. in this and other fields.

A4 **B.S.A. HARFORD PUMPS LTD., Northside House, Mountpleasant, Cockfosters, Barnet, Hertfordshire. (Telephone: HADley Green 2244).**

B.S.A. Harford Pumps Ltd. will be exhibiting their complete range of central heating equipment, and will also make available details of three new "packaged deals" for estate developers. The general theme of the stand will be in line with B.S.A. Harford's current campaign to interest architects, borough surveyors and estate developers in these packaged deals which comprise the complete design (in conjunction with material specification and technical description) of heating systems for estates of not less than six dwellings.

The highlight of the exhibits will be the Hotspur Mk.II oil fired boiler which has been extensively restyled and reduced in overall dimensions. The Hotspur Mk.II is available in four models covering output ratings of 45,000; 60,000; 80,000 and 110,000 Btu/h.

Also on show will be B.S.A. Harford's wide range of central heating pumps including the new Opiomatic 'Junior' which has been developed to include the smaller installation within its range and is thus smaller than the standard model; nevertheless its performance characteristics differ only slightly. Variation can be obtained by a setting device which matches the pump duty to the existing system resistance. The Opiomatic 'Junior' provides a wide selection of duties ranging from a minimum of 2·75 ft. head at zero flow and 1 ft. at 12 gal/min., to a maximum of 5·5 ft. head at zero flow and 2·5 ft. at 16 gal/min.

(*Entry continued overleaf*)

Control of Air Pollution

by

ALAN GILPIN, B.Sc., M.Inst.P., M.A.P.H.I.

is on display at
Stand A.21

BUTTERWORTHS
88 Kingsway · London · W.C.2

SEE THE

Husqvarna

'WARM-WIND'

CONVECTOR CENTRAL HEATING UNITS

From Sweden

ON STAND B7

Sole U.K. Agents A. H. BIBBEY (SALES) LTD.
High Wych, Sawbridgeworth, Herts. Tel: Sawbridgeworth 2050

Among the pump exhibits will be the Opixy which was displayed for the first time at this year's HEVAC exhibition with great success. This pump is designed for small sized, low pressure hot water, closed central heating systems up to a maximum water temperature of 200°F with a maximum air ambient temperature of 122°F. The Opixy is fully variable to any selected duty up to $5\frac{1}{4}$ gal/min.

The overall display will be completed by the remaining items in B.S.A. Harford's range, and will comprise steel panel radiators, the Kosmos thermostatic radiator regulator, the TA proportional radiator valve and the Mixford shunt valve.

A21 BUTTERWORTH (PUBLISHERS) LTD. 4-5 Bell Yard, Temple Bar, London, W.C.2. (Telephone: HOLborn 6900).

Control of Air Pollution by Alan Gilpin is a much-needed textbook dealing with the practical implementation of the Clean Air Act of 1956. The author, formerly a Chief Public Health Inspector, and currently Inspector for Air Pollution in the County Borough of West Bromwich, has had considerable experience of its application in both industrial and domestic problems and is therefore well qualified to assess past progress and possible future developments.

The introductory section of the book deals with the nature, effects and measurements of air pollution and this is followed by a description of fuels, furnaces and firing methods, concentrating on the scientific principles and technical engineering problems involved in relation to air pollution. The practical application of the Clean Air Act is covered in detail, including smoke abatement, grit and dust prevention, smoke control areas, domestic appliances and public transport. Finally the major problems of air pollution in industry, power stations, ceramics, lime and glass, atomic energy establishments, and motor vehicles are discussed; there is also a chapter on progress in odour control. In each case the responsibilities of the local authorities and Chief Public Health Inspectors are fully examined and a chapter is devoted to the important role of Alkali Inspectorate.

This is a very timely book and it will prove extremely valuable for students on Public Health and Smoke Inspection courses, local government officers, and those involved with oil, solid fuel, gas and electrical industries; although primarily a technical book, it could also be read profitably by the ordinary interested layman.

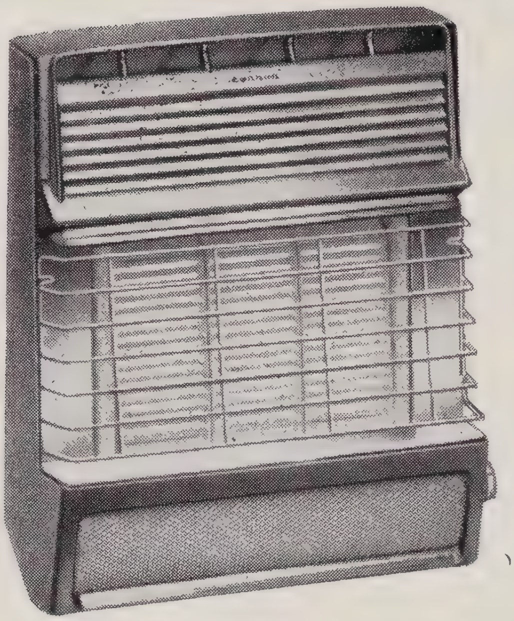
There are 514 pages, 162 illustrations, with 37 tables, and the price is 120s.

A selection of press reviews on "Control of Air Pollution":

"This new textbook is to be commended without reservation.

(*Entry continued overleaf*)

GasMiser 'Plus'



the new Fire which will Adequately and Economically heat the Larger Room in the Coldest of Weather Conditions

A Cannon Quality Product

CANNON INDUSTRIES LTD. (GAS APPLIANCE DIVISION) · DEEPFIELDS · BILSTON · STAFFS

COLLECTRON

solves dust problems

Everywhere!

6 special features

- **No filter bags or shaking mechanism required**
- **Capital costs as low as 3/6d per cu. ft. of air handled**
- **No risk of "blow-backs"**
- **Less than half the space required by cyclone and filter bag installations**
- **Negligible maintenance costs**
- **Suitable for high temperature gases**

Throughout industry today the COLLECTRON dust collection system, incorporating an entirely new "re-cycling" principle, is achieving remarkable results. Maximum efficiency is obtained with low capital costs

Delivery almost immediate *Write for illustrated brochure*

COLLECTRON LIMITED

32, AYLMER ROAD, LEYTONSTONE, LONDON, E.11. LEYtonstone 3085/4709
3 BROOK SQUARE, RUGELEY, STAFFS. RUGELEY 659/474

Stand No.

It brings together in one well-printed and amply illustrated volume, all the practical information that is indicated by its title."

Smokeless Air

". . . an excellent book, . . . will find a gap that has long existed."

Municipal Engineering

"This is a *must* for anyone engaged in, or concerned with, air pollution."

Civil Engineering

". . . an excellent major textbook. . . certainly deserves to be widely read by public health inspectors in industrial areas. It should also find its way into all libraries for students."

J. B. Meredith Davies in the *New Scientist*

A24 **CALOR GAS (DISTRIBUTING) LTD., 33 Cavendish Square, London, W.1. (Telephone: HYDe Park 8501).**

Featured on the stand are the Mark X range of pokers, both high pressure and low pressure types, also the new undergrate poker, all operating from the Handy Mark X cylinder.

All these appliances are ideal for use in smokeless zones.

B1 and B2 **CANNON INDUSTRIES LTD., Gas Appliance Division, Deepfields, Bilston, Staffordshire. (Telephone: Bilston 41241/5).**

The Cannon GasMiser Plus, the latest addition to the already famous range of GasMisers is the first fire to adequately and economically heat the large room. It is the first two-heat (radiant/convector) fire where the most serious loss of convected heat to chimney flue has been eliminated without the fitting of any form of flue restrictor or chimney flue break.

Primary Heat

The Primary Heat Source is Radiant Heat from the largest ever radiant heat panel (115 sq. ins.) giving quick impact, wide angle, high temperature heating of floors, carpets, furniture, furnishings, walls and ceiling more rapidly than any form of convected heat.

Secondary Heat

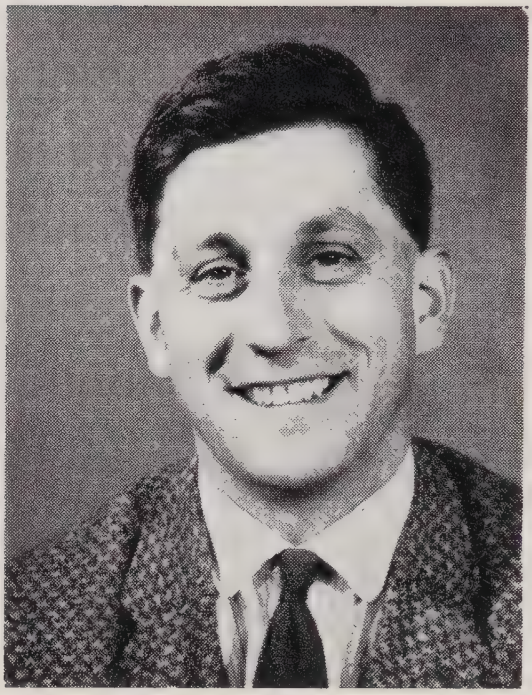
Convected heat provides a zone of hot air from ceiling downwards. The most efficient super-charged high temperature heat exchange convector area 15½ sq. ft. convects hot air at the high speed and temperatures of 400°F up.

For the Large Room

The GasMiser Plus—22,000 B.T.U. input is the Highest Input Rated fire, the Highest Heat Output to room fire and the most efficient under any working conditions. It will heat the large or

(*Entry continued overleaf*)

Power and David Moore—



clean
air
research
scientist
with
the
C.E.G.B.

Some details of the research being carried out on atmospheric pollution by Dr. David Moore, one of the team engaged on that work at the Central Electricity Reseach Laboratories, can be seen and heard on Stand B20/21.

Dr. Moore has recorded a description of his activities, and some of the measuring and recording instruments are on display.

Illuminated photographs also illustrate the unremitting efforts being made by the Generating Board to prevent air pollution, while supplying the cleanest of all sources of heat, light and power—electricity.

Responsible for the generation and main transmission of electricity in England and Wales

CEGB

any size room more quickly and maintain it to higher temperature in the coldest of weather conditions or provide just sufficient low heat for that chilly summer evening or economic low rate all-night comfort heat.

Fit and Forget

The GasMiser Plus is the first fire you "fit and forget" to any size, shape or height of chimney flue. It will function to the maximum heat exchange to room and conversely with a minimum heat loss of fire to chimney flue in the lowest temperature and the worst atmospheric—strong chimney flue conditions.

The GasMiser Plus provides Instant, Fresh, Healthy, Economic heat under fingertip control to cope instantly with any temperature and weather conditions.

GasMiser Plus is of a pleasing conservative design which ensures that it will merge, harmoniously with any type of modern or period furniture or decor—and any subsequent furniture or colour change. It is a superbly "Cannon Quality" engineered fire which, with an occasional wipe over, will maintain its showroom condition indefinitely.

B20 and B21 **CENTRAL ELECTRICITY GENERATING BOARD, Bankside House, Summer Street, London, S.E.1. (Telephone: WATerloo 2011).**

An air pollution research scientist's personally-recorded description of his work is the highlight of this year's display by the Central Electricity Generating Board. The commentary, made by Dr. David Moore of the Central Electricity Research Laboratories, is synchronized to a number of photographic transparencies illustrating various aspects of the activities described.

A working model demonstrates the function of electrostatic precipitators in power stations. An instrument used for measuring and recording air turbulence, as currently in use in experiments taking place near Tilbury power station, Essex, is shown in action.

Other features include actual atmospheric grit samples greatly magnified; two sections of 275,000 volt overhead line insulators, one clean and the other polluted; devices for the measurement of acid smuts and optical density and a variety of information on the Generating Board's efforts to minimize atmospheric pollution from power stations.

RESERVE YOUR STAND SPACE **NOW**
FOR NEXT YEAR'S
CLEAN AIR EXHIBITION – EASTBOURNE
26 - 29 OCTOBER
FLOOR PLAN AVAILABLE IN EXHIBITION ORGANIZER'S OFFICE

CALL THE CUC

for advice on solid fuel domestic heating

C.U.C. stands for Coal Utilisation Council. It has been in existence for over 30 years, and since the war has been the recognised official authority on the domestic use of solid fuel.

The C.U.C. can offer technical advice on every aspect of solid fuel domestic heating. Technical experts are available in each of the Council's regions.

FOR FURTHER INFORMATION

visit Stand No. A.6—A.10

Issued by the Coal Utilisation Council, 19 Rochester Row, London, S.W.1

Stand No.

A6 to A10 **COAL UTILISATION COUNCIL, 19 Rochester Row, London, S.W.1. (Telephone: VICtoria 2339). And at Aberdeen, Birmingham, Bristol, Cambridge, Cardiff, Edinburgh, Glasgow, Leeds, Manchester, Newcastle-upon-Tyne, Nottingham, Plymouth, Reading and Tunbridge Wells.**

The Coal Utilisation Council is a non-commercial organization for promoting the efficient domestic use of solid fuels. In existing or proposed smoke control areas, the Council's policy is aimed at the retention of the domestic market for solid fuel, either by the smokeless burning of coal, as for example, by means of mechanical stokers, or by the use of smokeless solid fuel in modern approved appliances in the home, examples of which are on display. The Memorandum on Smoke Control Areas, published by the Ministry of Housing and Local Government, quote the Coal Utilisation Council as one of the organizations from which local authorities contemplating the establishment of smoke control areas may obtain advice and assistance.

The various publications issued by the Coal Utilisation Council are displayed, including a list of Approved Domestic Solid Fuel Appliances (published jointly with the Solid Smokeless Fuels Federation) from which solid fuel burning appliances for replacement in smoke control areas must be chosen.

On display is a range of the latest type of tested and approved appliances, including deep ashpit open fires, room heaters, domestic and central heating boilers. Working exhibits will be a deep ashpit fire with high output boiler heating radiators, an inset room heater, a free standing room heater, and a free standing cooker with water heater.

Information is obtainable on the stand of the training facilities available to the local authorities and the trade. These courses deal with the various types of solid fuel heating appliances and the problems arising in their installation.

The Women's Advisory Council on Solid Fuel has an information section on the stand and members of the staff will be present to discuss with delegates any assistance which can be given to local authorities promoting smoke control through women's meetings, etc.

C1 **COALITE & CHEMICAL PRODUCTS LTD., P.O. Box 21, Chesterfield, Derbyshire. (Telephone: Bolsover 2281).**

Live "Coalite" fires in open fire and cooker can be seen on the Stand. Large "Coalite" is the ideal smokeless fuel for every type of domestic grate, old or new, and openable or closeable stoves and hot water boilers.

"Coalite", which is very reactive, will laze or blaze according

(Entry continued overleaf)

More COALITE for open fires in smokeless zones

Expanding production—increasing supplies

Coalite, the modern smokeless coal, is recognised as a perfect fuel for consumers living in smokeless zones. It burns warm and well; without clinker—and without smoke or soot. Clean air—and yet a friendly open fire. No need for expensive conversions. Coalite Nuts should be used for cookers, stoves and boilers.

To meet the demands of the new smokeless zones, Coalite & Chemical Products Ltd., have been expanding fast. Nine new batteries of carbonising retorts have been commissioned since November 1963—and three more will be in action by the first quarter of 1965. This will boost output by at least 42%.

Coalite is the perfect answer to smokeless zone problems

'COALITE'

THE MODERN SMOKELESS COAL

to requirements. It may be allowed to laze throughout the night or, on other occasions when not required, but will draw up to a cheerful blaze immediately the air regulator is opened.

"Coalite" is readily ignited in the ordinary way with paper and sticks, fire lighter or gas poker and burns cheerfully with flame giving radiant heat, maximum comfort and economy.

"Coalite" is equally suitable as best house coal for the open fire and can be obtained from all leading coal merchants.

Prices vary throughout the country according to the geographical position in relation to the Works and carriage charges that are involved. It is sometimes said that "Coalite" is expensive and, whilst it may be true when this is considered initially in terms of shillings per hundredweight, the important point is that one buys by weight and consumes by volume. As "Coalite", all of which burns away without risk of flying pieces, is of greater volume than coal, it is cheapest in the long run.

It is most important to note that "Coalite", which is an approved smokeless coal, will burn satisfactorily in any type of grate or appliance without the expense of alteration.

B22 to B24 **COLLECTRON LIMITED, London Office: Aylmer Road, Leytonstone, London, E.11. (Telephone: LEYtonstone 3085/4709). Midland Office: 3 Brook Square, Rugeley, Staffs. (Telephone: Rugeley 659).**

Collectron Limited of London, and Rugeley, Staffs, are showing a Mark II model recycling type High Efficiency Dust and Fine Particle Recovery Unit, High Efficiency Fan Irrigation Cyclone manufactured in P.V.C., a recently developed Airscreen capable of separating powders or dusts of different size and shape without the use of screening cloths or meshes.

A further exhibit is a new Electrostatic Power Pack designed for operating the Electrostatic Precipitators, recently introduced in the United Kingdom by the Company.

A range of Continuous Discharge Valves operating on the "Double Gate" principle is also on show and a team of specialist engineers is available to answer any questions connected with problems of air pollution, dust control, fine particle recovery, etc.

B18 **DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, State House, High Holborn, London, W.C.1. (Telephone: CHAncery 1262).**

Warren Spring Laboratory, Gunnels Wood Road, Stevenage, Hertfordshire. (Telephone: Stevenage 2080-8).

The subject of smoky diesel exhausts has been raised time and again in recent years—at Clean Air Conferences, in the press and

(*Entry continued overleaf*)

Estd *1829*

Banking Facilities at the National Clean Air Exhibition

All exhibitors and visitors are invited to make full use of the banking facilities which we have made available in the Exhibition Hall at Harrogate from October 20th to 23rd.

STAND No. A11

Our representatives will be pleased to see you.

DISTRICT BANK

LIMITED

OVER 570 BRANCHES AND STEADILY EXPANDING

HARROGATE BRANCH: 49 JAMES STREET
Manager: Mr. R. M. Shaw

Stand No.

in Parliament. The material on the Stand outlines Warren Spring Laboratory's contribution to research on this problem.

The work falls broadly into two stages. The first stage, reported to the Conference in 1960, consisted of attempts to find a simple, inexpensive method of removing the smoke from the exhaust system before it could be emitted into the atmosphere. None of the methods tested was entirely successful. It was established, however, that efficient operation and maintenance reduced the formation of smoke to a minimum.

In the second stage, therefore, research was devoted to methods of measuring the smoke produced by diesel vehicles on the road, with a view to providing a basis for preventive action. One study was concerned with investigating the correlation between smoke produced on the road and that produced by the same vehicle in a "free acceleration" test with the vehicle stationary. Another consisted of subjective judgments by a panel of observers on whether the exhausts of vehicles emitting a known amount of smoke were objectionable or not.

As a result of these tests, the Laboratory has collected sufficient data to form a basis for the systematic detection of the worst offenders among diesel vehicles by off-the-road tests if such a system should be proposed.

A11 DISTRICT BANK LTD., 17 Spring Gardens, Manchester, 2 (Telephone: DEAnsgate 4300).

We shall be glad to see delegates, exhibitors and visitors at our stand in the Exhibition Hall and invite you to make full use of our banking facilities, either on the stand or at our local branch, 49 James Street, Harrogate.

C10 PAUL DONG (Member of the Institute of Journalists), 20 Freshford Street, Earlsfield, London, S.W.18. (Telephone: WIMbledon 9766).

The official photographer will have on display as soon as they are available proof copies of photographs taken at the official opening of the Conference and Exhibition, the tour of the exhibition by V.I.P's, receptions, etc. Exhibitors and delegates may order copies by completing an order form on the stand and placing it in the box provided.

Also on display will be photographs connected with air pollution, which are available for the use of public authorities and commercial enterprises. These photographs supplement those which are available from the National Society for Clean Air's Library.

(*Entry continued overleaf*)

'Off-peak' electric storage heating is officially recommended for future Smoke Control Areas

(*See Ministry of Housing and Local Government Circular No. 69/63*)

Electric storage heaters meet all the requirements of the Clean Air Act.
Cheap to install. For existing premises, Unit-plan storage heaters are ideal – all that is needed for installation is a simple wiring job. For buildings still at drawing-board stage, electric floor warming is the cheapest system of all – it is incorporated as an integral part of the structure.
Cheap to run. Electricity is available at 'off-peak' rates. The cost per unit may be as little as *one-half* the normal rate.
Clean and convenient. 'Off-peak' electricity provides today's cleanest and most convenient form of heating. It complies *in every respect* with the requirements of the Clean Air Act. Electric storage heating supports the Government's intention of encouraging vigorous action against pollution of the air in our cities and towns. It can make important contributions to this policy.
Free leaflet entitled "When your neighbourhood becomes a Smoke Control Area . . . here's how Electricity can help you" – written to advise and inform the public. Get your copy from the Electricity Stand, or the address below. Bulk supplies obtainable through your Electricity Board.

Visit the *Electricity* Stand No. A2

ELECTRICAL DEVELOPMENT ASSOCIATION (P/CA), 2 SAVOY HILL, LONDON W.C.2

Stand No.

Enquiries are invited regarding all types of Public Relations, Industrial and Record photography. The Photographic Office and the Darkroom for the Conference and Exhibition is located above the Club Bar in the Royal Hall.

After the conclusion of the Conference and Exhibition, photographic enquiries and orders should be sent to the above address.

A2 **ELECTRICAL DEVELOPMENT ASSOCIATION, 2 Savoy Hill London, W.C.2. (Telephone: TEMple Bar 9434).**

Electricity—the versatile "fuel" now offers cheap current "off-peak" for house warming and hot water. Electric Underfloor Heating is ideal for new houses, and the Unit-Plan and Ducted Warm Air Systems are suitable for either new or existing houses and flats. Off-peak heating systems cost a great deal less to install than other methods and running costs are low.

Advice on wiring, electrical equipment for new housing schemes or modernization projects and other spects of electricity's services is readily available on the stand and there is on display a selection of the latest electric cookers, refrigerators and other home appliances, some of which have been specially designed for estate use.

E.D.A. technical and advisory literature is freely available.

A12 **ELLIOTT PROCESS AUTOMATION LTD., (A member of the Elliott-Automation Group), Abbey Road, Park Royal, London, N.W.10. (Telephone: ELGar 8811).**

As previously, emphasis is again on instrumentation for efficiency concerned with boiler and furnace efficiency by means of gas analysis and dust monitoring equipment as playing a leading part in air pollution and clean air problems.

The equipment comprises:

Gas Analyzers (*Mechanical*). Mono chemical Orsat type for CO_2, CO_2 and $CO+H_2$, O_2, etc.

Gas Analyzers (*Electrical*). Elliott thermo conductivity meters for CO_2.

Gas Analyzers (*Portable*). Mono chemical CO_2 and combined CO_2, flue gas temperature and draught.

Heat Loss Indicator. Elliott indicator for CO_2 and flue gas temperature giving combined reading for simple boiler chimney heat loss appreciation.

Dust Monitors (*Fixed*). Gordon Konitest Dust Meter Mark IV for permanent installation for boiler and precipitator outlets for pulverized fuel fired boiler plant.

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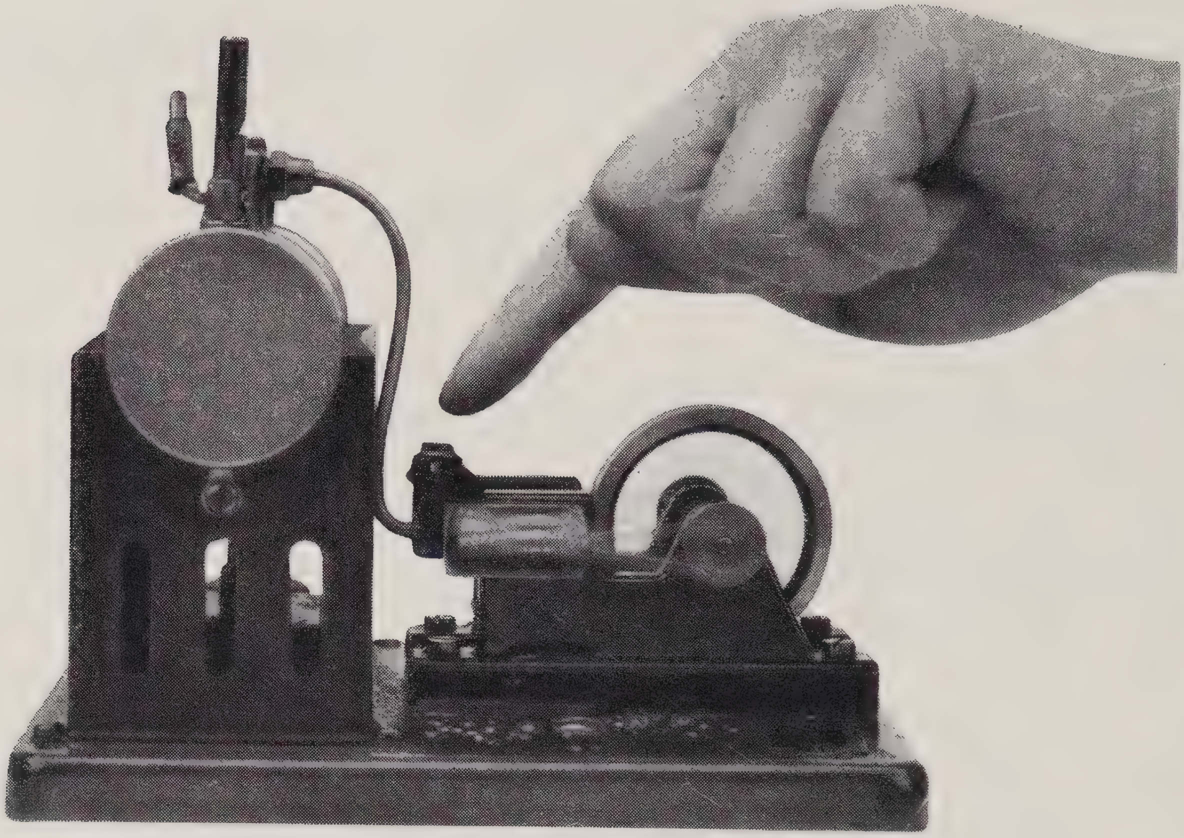

ELLIOTT MAKE CHILD'S PLAY OF BOILER CONTROL

Vast experience in instrument making, and the application of instrumentation to industrial processes, enable us to provide a unified, *comprehensive* service for the instrumentation and control of boiler and furnace plant of all types.

We advise *on every phase* of your problem: initial examination, the correct application of your particular plant, followed up by detailed specifications and estimates.

No task is too big or too small for us. Your contract is handled by specialist engineers, behind whom stand the technical and manufacturing resources, the after-sales service and maintenance, of the largest instrument company in Europe.

An Area Engineer, fully experienced in every detail of customer application is resident in London and the Home Counties, Newport, Birmingham, Stockport, Newcastle, Glasgow and Dublin.

Please Contact:

ELLIOTT

ELLIOTT PROCESS AUTOMATION LTD
ABBEY ROAD · PARK ROYAL · LONDON · NW10
Tel: ELGar 7641 Telegrams: ELFLOMETA, LONDON. Telex No. 23196

EA A Member of the Elliott-Automation Group

Dust Monitors (*Portable*). Gordon Konitest Dust Meter Mark V for easy testing of dust loading conditions whereby simple evaluation of boiler and dust collecting plant can be checked as to dust burden and efficiency of plant.

B14 and B15 **THE GAS COUNCIL, 1 Grosvenor Place, London, S.W.1. (Telephone: BELgravia 4321).**

The Gas Council's stand has the latest information on how gas is helping the drive for clean air.

In December 1963, the Minister of Housing and Local Government announced that, in new Smoke Control Areas, gas fires, among other forms of heating, should be regarded as "reasonably necessary" works, and that the full expenditure on such installations should rank for grant.

It is evident from the record level of sales of radiant-convector gas fires that the public wants gas. It is clean, labour-free and always on tap. An important adjunct to the efficient and economical heating of today's gas fires is controlled ventilation which provides two to three complete air changes per hour, thus ensuring a fresh, healthy atmosphere. A range of modern gas fires can be seen at the Gas Council's stand.

Also on display are the latest gas cookers, water heaters and refrigerators into most of which interesting new developments have been incorporated.

The Gas Council is also showing gas central heating systems. The installations on display show how simply both small bore and warm air systems can be installed in new and existing property with a minimum of structural work.

High Speed Gas has the answer to smoke control problems. Gas industry experts will be in attendance to help and advise you.

C4 **GLOW-WORM BOILERS LIMITED AND RHEEM GLOW-WORM LIMITED, 47 Hatton Garden, London, E.C.1. (Telephone: CHAncery 6971)**

One completely new exhibit from Glow-Worm is a gas fired convector heater, rated at 12,000 B.Th.U./hr. and provided with thermostatic control. This heater is enclosed in a contemporary style wooden cabinet, has a cast iron heat exchanger and a balanced flue capable of adjustment to any wall thickness up to 18 inches.

Two solid fuel room heaters are also being shown for the first time and the balance of the exhibit is made up from a selection from the comprehensive Glow-Worm and Rheem Glow-Worm range of solid fuel, oil and gas fired boilers and appliances.

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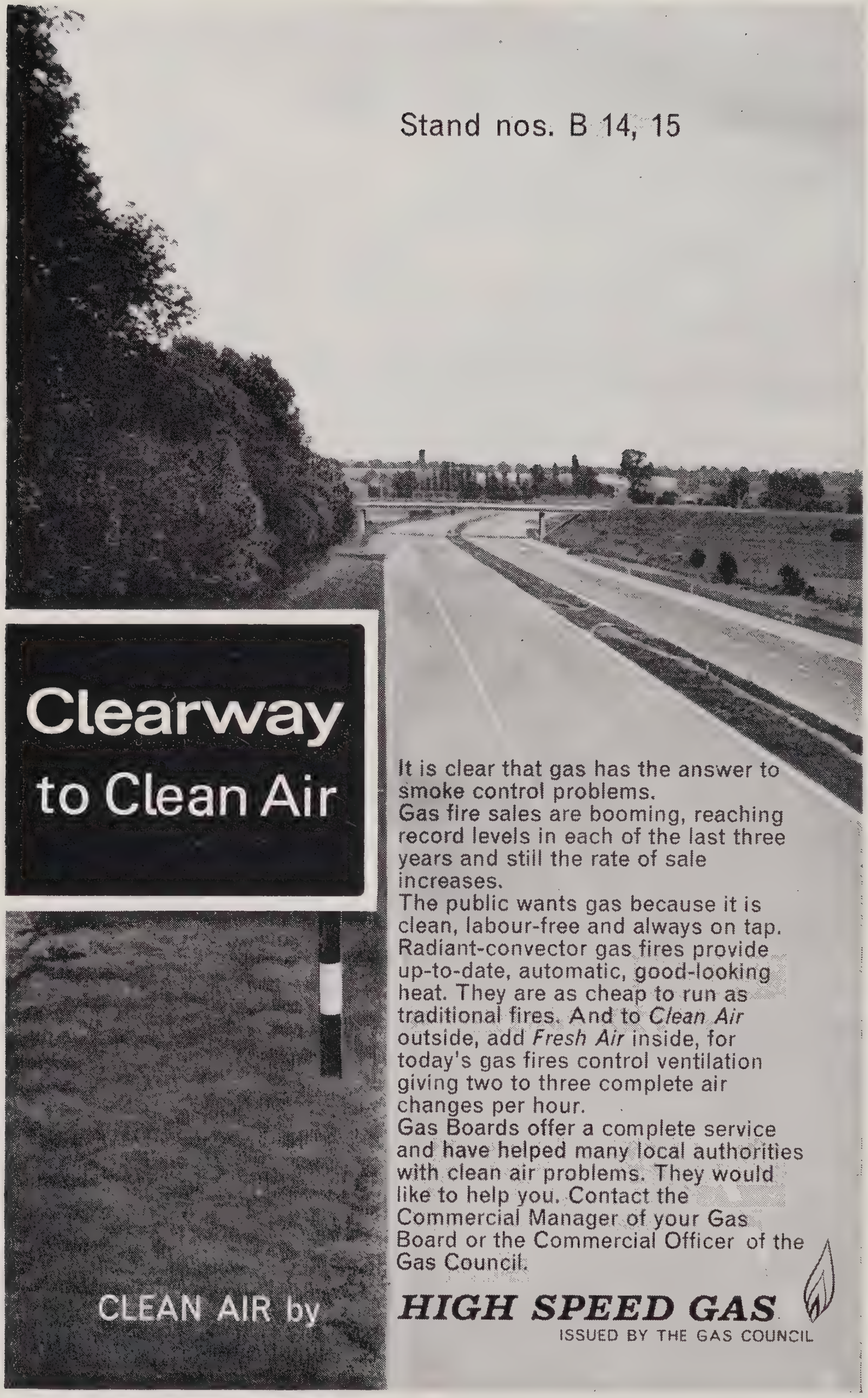


It is clear that gas has the answer to smoke control problems.
Gas fire sales are booming, reaching record levels in each of the last three years and still the rate of sale increases.
The public wants gas because it is clean, labour-free and always on tap. Radiant-convector gas fires provide up-to-date, automatic, good-looking heat. They are as cheap to run as traditional fires. And to *Clean Air* outside, add *Fresh Air* inside, for today's gas fires control ventilation giving two to three complete air changes per hour.
Gas Boards offer a complete service and have helped many local authorities with clean air problems. They would like to help you. Contact the Commercial Manager of your Gas Board or the Commercial Officer of the Gas Council.

HIGH SPEED GAS
ISSUED BY THE GAS COUNCIL

The recently introduced Rheem Glow-Worm warm air central heating unit is on show. This appliance is available in three sizes, 35,000, 53,000 and 70,000 B.Th.U./hr and incorporates American design studded airways for maximum efficiency. An all enveloping steel cabinet is lined with aluminium-foil faced fibre glass insulation and finished in two-tone stove enamel.

Fibre glass insulation is also used in the Rheem Glow-Worm gas fired water storage heater on show. Three models, 17, 26 and 33 gallon capacity are available.

Gas fired boilers on show include the Thermglow MkIII (30,000 B.Th.U./hr.), G.50 (50,000) and G.75 (75,000). All are available as top or balanced flue models, with a choice of controls and as complete small bore packaged units. Both the "G" models incorporate the Sunrod copper rod heat exchanger surface, which improves efficiency and reduces overall size.

Finally, solid fuel is represented by one of Glow-Worm's sectional construction boilers, the GW.33. This boiler is thermostatically controlled and rated at 33,000 B.Th.U./hr.

B6 **HEATSTORE LTD., 22 Chapel Lane, Pinner, Middlesex. (Telephone: FIEld End 0166/7/8).**

Heatstore Ltd., leading manufacturers of thermal storage heaters, exhibit examples of their commercial range of heaters and their full range of domestic heaters with Heatspan and Heatshelf specially tailored shelves on Stand B6.

Although one-third less in size than previous models, the new slim-line heaters have an increased thermal capacity which allows them to dispense with the mid-day boost of current. This has cut running costs by 10 per cent.

Heatstore is fully automatic and after installation requires no attention. Its ease of installation is one of the great advantages of this type of central heating. No pipes or boilers are required and no builders' work is involved. All that is needed is a simple wiring job to gain the benefit of the cheap off-peak tariff.

The domestic Heatstore units are available in a choice of three finishes—fawn and cream, imitation wood and cream and black and magnolia. Separate front panels are available in a choice of pastel shades.

Retail prices of the fawn and cream and black and magnolia models are £20 10s. for the 1·5 kW. model, £22 for the 2·25 kW. model and £26 10s. for the 3 kW. model. Prices of the imitation wood model are £21 15s., £23 10s. and £28 5s.

This means that a complete central heating system can be installed in a typical three-bedroomed house for approximately £165 with an annual running cost of only £50–£60 on present off-peak tariff rates.

(*Entry continued overleaf*)

now slimmer, smaller, more efficient than ever!

HEATSTORE

SUPERSLIM ELECTRIC STORAGE HEATERS

N.B. Local authorities can now regard the installation of electric storage heaters as reasonable work which could qualify for a grant—see M. of H Circular 69/63.

HEATSTORE LTD., 22 Chapel Lane, Pinner, Middlesex. Field End 0166/7/8

The new improved HEATSTORE is 2″ slimmer, smaller by a third, and now so efficient that the normal mid-day boost can be dispensed with. The running cost is actually 10% lower than with heaters needing a mid-day boost. Furthermore, a new special safety cut-out ensures complete reliability.

Specially packed for easy assembly. Heatstore is supplied in lightweight packaged units—the average weight of which is 60 lb.—ready for immediate assembly. A wide range of 3-colour finishes blends with any surroundings in the home and in industry.

Quick delivery. Heatstore can be supplied in three sizes: 1½, 2¼ and 3kW, equipped for individual or group control.

SEE IT ON STAND B6

TA992

Demand for the heaters is rising so rapidly that the production programme at the three Heatstore factories has been doubled this year. Three of the new heaters are being produced every minute and one domestic storage heater in every four bought in Britain is a Heatstore.

Heatspan and Heatshelf, wrought iron and ripple plate glass shelves, are attractive extras specially designed to fit the Heatstore units to provide a useful space for the telephone, ornaments, plants or magazines.

Heatstore's Industrial Advice Service is being consulted by industrialists, property developers, local authorities, and architects. They will plan a large-scale installation for any prospective customer.

Architects and consultants have found that this type of heating speeds up multi-storey construction as only normal wiring is necessary, the installation being controlled by a time switch.

The industrial Heatstore units in a hammered bronze finish retail at £16 10s., £18 10s. and £23 10s. for the 1·5, 2·25 and 3 kW. models respectively.

B4 **HODGKINSON BENNIS LTD., Little Hulton, Walkden, Manchester. (Telephone: WALkden 3213). Brettenham House, Lancaster Place, Strand, London, W.C.2. (Telephone: COVent Garden 2188).**

'Centurion' Automatic Domestic Boiler—Designed and manufactured by Hodgkinson Bennis Ltd. this is a miniature combined underfeed stoker and water tube boiler for small bore central heating systems. This appliance is rated at 80,000 Btu. per hour and is complete with a control panel. It automatically collects the coal from outside the house and burns it completely smokelessly. As it is designed to use cheap industrial singles it is by far the most economical domestic central heating and hot water unit.

C6 **KAVAG, 6461 Gondsroth/Hessen, West Germany. U.K. Office: Somerset House, George's Square, Halifax, Yorkshire. (Telephone: Halifax 65109).**

"Kavag", a subsidiary of Universal Oil Products Co. and a sister company to the Catalytic Combustion Co. are specialists in the field of fume and odour removal by catalytic combustion methods.

They will be exhibiting an illuminated flow diagram of a catalytic combustion unit as applied to an industrial oven.

Also on display will be the catalyst elements used in this process, together with a working model of catalytic combustion equipment. This model demonstrates the effectiveness of the

(Entry continued overleaf)

FUMES

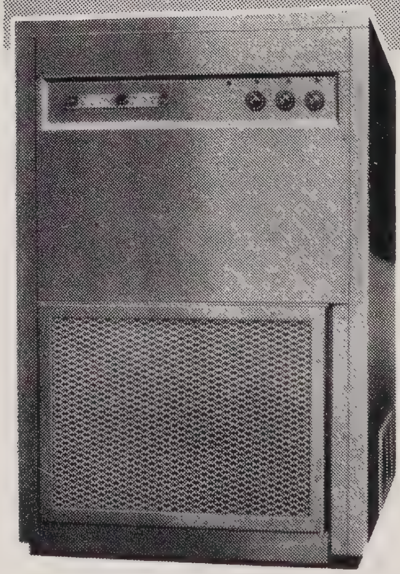
SMELLS

SEE THE EXPERTS ON COMPLETE
ELIMINATION OF SMELLS AND FUMES

KAVAG

Gondsroth
West Germany

STAND C6



LUCAS CLIMASTOR

ducted air central heating storage heater
model FS121T

Heat energy is stored within the unit and released as and when required through unobtrusive, fully controllable grille outlets by means of a quiet, slow running thermostatically controlled fan.

Low capital cost on installation. Low running cost — using off-peak electricity.

See also the full range of Climatrix heaters on our stand.

Stand C16

LUCAS INDUSTRIAL EQUIPMENT LTD.
THROSTLE MILL WORKS . BURNLEY . LANCS.

system in completely removing colour and smell from a fume stream.

The catalytic system has been used in Great Britain for such industries as Protein Hydrolysis, Brake Shoe Ovens, Phthalic Anhydride, Wire Enamelling, Bacon Smoking, Nitric Acid, etc. etc.,

(a) inside entrance **KAY BROS. LTD., Reddish, Stockport, Cheshire. (Telephone: Heaton Moor 1811). (A Reckitt and Colman Group Company).**

"Zip'' firelighters on display are "to all intents and purposes", smokeless and therefore suitable for use in smoke control areas. This is the verdict of the Ministry of Housing and Local Government.

B9 **LECTROMATIC HEATING SYSTEMS LTD., 111 St. Georges Road, Bolton, Lancashire. (Telephone: Bolton 23767). London Branch: Lloyd's Bank Chambers, Henrietta Street, London, W.C.2. Birmingham Branch: 51 Queen Street, Sutton Coldfield, Warwickshire. Yorkshire Branch: 15 East Parade, Harrogate, Yorkshire.**

A wide range of Thermal Storage Heaters are on display on this stand, all designed specially to use the cheap HALF PRICE "off-peak" electricity tariffs. There are models which can be fully controlled to provide as little or as much heat as required within the capacity of the heater, and the control is exercised by either a unique damper arrangement or by means of an internal fan. There are heaters finished in a beautiful natural mahogany to enhance the decor of your home, which operate as Thermal Storage Convector heaters and others finished in attractive stove-enamelled metal cabinets of ultra slim design to operate as Thermal Storage Radiators.

Thermal Storage Heating is the only genuine full Home Heating System that can be installed room by room in accordance with finances available, and which requires no structural alterations at all. The work is normally completed within two days without mess or damage to decorations and additions can be undertaken at any time in the future.

Personal Loan arrangements are available at a very low rate of interest and the interest paid is chargeable against income tax so that the entire system may be installed for monthly outgoings well within the average householders capacity to meet. In addition, the cheap "off-peak" tariffs allow full Home Heating with Thermal Storage Heaters for little more than the cost of one open fire. Thermal Storage Heating is the least expensive Home Heating to install and to operate and provides comfortable summer time temperatures throughout the winter.

Stand No.

A22 "LOCAL GOVERNMENT CHRONICLE" (Charles Knight and Co. Ltd.), 11-12 Bury Street, St. Mary Axe, London, E.C.3. (Telephone: MANsion House 5477).

You are invited to call at our stand for a copy of *The Local Government Chronicle*, the old-established municipal weekly paper with the new look. Widely recognized by local government officers as reliable and a great help to them in their work, the "*L.G.C.*" carries surveys and articles on new legislation as well as prompt and discerning coverage of all major happenings in local government.

The "*L.G.C.*" is something of an institution in local government as its very wide readership bears witness. Each year, an independent audit is carried out on its circulation by the Audit Bureau of Circulations. This reveals that it has the highest A.B.C. audited circulation in the field of municipal weeklies—and its growth in recent years has been accelerated.

The paper was founded in 1855 by Charles Knight, the versatile author, editor, printer and publisher—best known perhaps for his "Penny Cyclopaedia", the forerunner of the modern encyclopaedia. Among his publications which flourish to this day is "Knight's Public Health Acts". With the advent of the public health legislation of the 1870's, the paper grew and expanded—and raised its price to 3d.

Still published by the firm of Charles Knight & Co. Ltd., *The Local Government Chronicle* now costs 1s. 3d. weekly on order from any newsagent or can be obtained direct from the publishers at 11–12 Bury Street, London, E.C.3, at £3 18s. per annum, postage included.

B25 LONOR LIMITED, 1 Maddox Street, London, W.1. (Telephone: REGent 4114).

Sole distributors in U.K. for SIEMENS-ELECTROGERATE A.G.

Siemens of Western Germany, well known throughout the world for their precision and quality products, present the following selection from their range of electrical appliances.

Hand Drier TH.31 (MT.31)—silent, compact and efficient. Designed for use in all toilets, washrooms and public conveniences, when one or many pairs of hands need drying quickly, hygienically and economically.

Water Boiler BK.05—hot or boiling water. Automatic control; eye-level water gauge; easily installed; suitable for use wherever boiling water is required quickly.

Wall-Mounted Heater OW.12—safe; space-saving in design but giving full scale space-heating. Automatic anti-frost device. Suitable for bathroom and kitchen. Operates on 750, 1,250 or 2,000 Watts.

Rotary Ironers WB.51/WB.61—extremely easy to operate. All articles of laundry can be ironed perfectly and effortlessly and in comfort. Fabric index; heat control dial; thermostatically controlled for each type of fabric to be ironed.

Stand No.

C16 LUCAS INDUSTRIAL EQUIPMENT LTD., Throstle Mill, Burnley, Lancashire. (Telephone: Burnley 4564).

The theme of the Lucas stand at this exhibition is Central Heating and Air Conditioning and a wide range of products and systems are shown which are designed to meet every need in the electrical heating field.

Undoubtedly one of the most popular of the Lucas range is the 12 kW. Thermal Storage Ducted Air Central Unit (Climastor FS121T) which has been designed to fit conveniently into modern homes. The economical running of this block storage heater due to the use of cheap rate, off-peak tariff electricity is just one of the many exciting features which makes this "first choice" when considering central heating.

A fully selective ducted air central heating unit (Climatrix 91) is also exhibited which is automatically controlled by built-in or remotely mounted time clock and room thermostat. Selection of three different heat levels, each with its own fan speed enables desired warmth to be spread to any area of the house selected.

A new concept in modern hearth-side luxury is introduced in the form of the Lucas Focal Point fire range. These slimline electric fires of 3 kW. output have either simulated log or coal effect fitted in a stylish cabinet with choice of polished walnut surround.

Complimenting the Climatrix range is a new slimline electric Convector heater, No. C21, with extra wide warm air grille. Its long low look is more than a masterpiece of styling.

Other appliances exhibited include 2 kW. and 3 kW. Portable Fan Heaters, Bed Warmer, Overhead Heat and Light Unit and Portable Infra-Red fire.

Literature is available on stand No. C16 which will tell visitors all they need to know about the full range of Climatrix domestic and industrial heating appliances.

VISUAL AIDS FOR LECTURERS AND TEACHERS

COLOUR FILMSTRIPS

WITH AUTHORITATIVE DETAILED NOTES

AIR POLLUTION
by **Professor R. S. Scorer**

Part A. Nature, Production and
DW-F22 Effects of Air Pollution

Part B. Dispersion and Accumulation of Air Pollution;
DW-F23 Behaviour and Appearance of Smoke.

CHRONIC BRONCHITIS
DW-F28 by **Dr. J. L. Burn,**
Past Chairman,
National Society for Clean Air.

These three colour filmstrips are in 35mm x 24mm picture size and may be cut up and used as slides

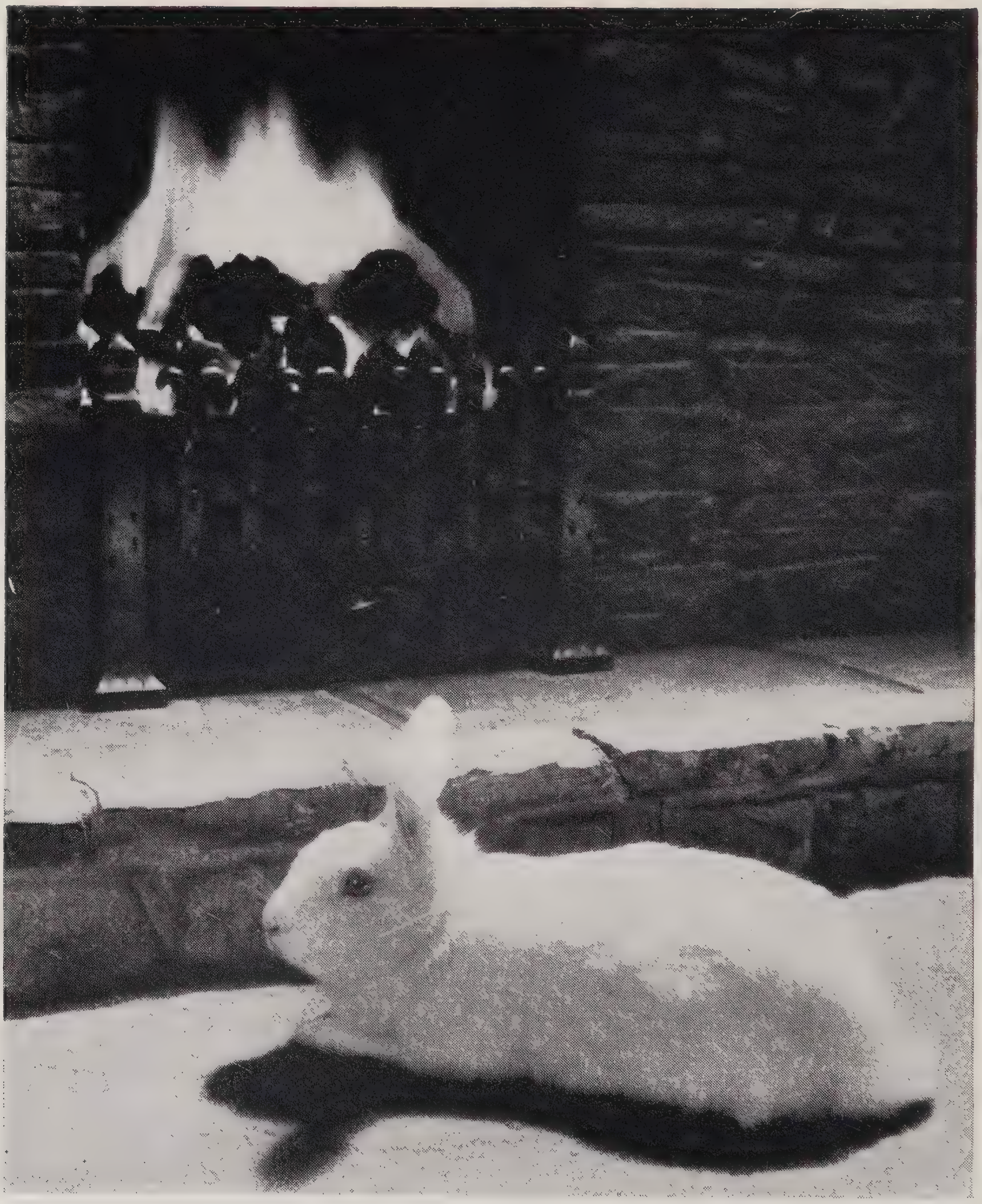
Each strip, with notes, price £2

Produced and distributed by: DIANA WYLLIE LTD., 3 Park Road, Baker Street, London, N.W.1

REXCO

SMOKELESS COAL

gives far more pure heat!



NATIONAL CARBONISING COMPANY LTD · MANSFIELD · NOTTS.

Stand No.

B16 and B17 **MINISTRY OF HOUSING AND LOCAL GOVERNMENT, Whitehall, London, S.W.1. (Telephone: WHItehall 4300).**

Regional maps of England and Wales are exhibited on the Ministry stand. These show, town by town, the areas under smoke control on 31st July, 1964. Copies of recent circulars will be available.

C9 **H. MORFITT & SON LTD., 10 Princes Street, Harrogate, Yorkshire. (Telephone: Harrogate 4482).**

Suppliers and installers of all types of space heating, central heating, hot air heating and domestic appliances approved by Coal Utilisation Council in various price ranges. Estimates for installing or supplying any type of equipment of any size will be given free of charge.

We are the official flue contractors for this exhibition.

A20 **THE MUNICIPAL JOURNAL GROUP OF COMPANIES, 3-4 Clement's Inn, London, W.C.2. (Telephone: HOLborn 5502).**

The Municipal Journal Group of Companies welcomes you to Stand No. A20 where there is a display of the Group's many publications—featuring *The Municipal Journal* and *Municipal Engineering*. The *Municipal Journal* covers every aspect of local government: Administration, Finance, Architecture, Health and Welfare. *Municipal Engineering* is local government's leading technical weekly.

Other publications on display by The Municipal Journal Group are:

Municipal Engineering.
The Municipal Year Book.
The Digests of New Legislation.
The Councillor's Handbook.
Local Government Today . . . and Tomorrow.

Municipal and Industrial Exhibitions Ltd., an associate company of the group, is responsible for organizing the following exhibitions: The Association of Public Health Inspectors, National Housing and Town Planning Council, Chief Fire Officers Association, Institution of Fire Engineers, British Fire Services Association, Institution of Works and Highways Superintendents, and Federation of British Fire Organisations.

The Municipal Agency Ltd. also an associate company of the group, organizes the Public Works and Municipal Services Exhibition held biennially at Olympia, London.

LOOK— NO SMOKE!

Information and advice on smokeless solid fuels and appliances approved for use in Smoke Control Areas are readily available on Stand C3, or from the nearest Regional Sales office of the **NATIONAL COAL BOARD.**

Stand No.

A1 **NATIONAL CARBONISING COMPANY LIMITED and SCOTTISH REXCO LIMITED, Fullarton Lodge, Crow Hill Drive, Mansfield, Nottinghamshire. (Telephone: Mansfield 2357-9). London Office: "Thorney House", 34 Smith Square, Westminster, London, S.W.1. (Telephone: ABBey 6086).**

The makers of Rexco Smokeless Coal have as the main feature of their stand a typical British fireside scene. It shows a lounge with an open fire blazing merrily in the hearth.

The preservation of this traditional scene in homes throughout the country is being made possible—despite the regulations of the Clean Air Act—by the existence of Rexco "Approved" solid fuels.

This modern form of heating in a traditional setting becomes increasingly popular every year and the National Carbonising Company is constantly stepping up its production.

Rexco is made from the finest quality large coals and when burned produces bright flames and a strong radiant heat without smoke.

It is easily ignited and can be used successfully in any type of grate, old or new, thus avoiding the need to fit special grates and provide gas ignition.

The appliance under-fire and burning Rexco is the new Red-Fyre +5 inset room heater with large back boiler. This appliance is on show for the first time at the National Exhibition. The Red-Fyre room heaters are with an output of 21,000 Btu/hr and supply ample warmth by radiation and convection for a good sized living room, say 1,650 cu. ft. The powerful Red-Fyre boiler will provide 90 sq. ft. of radiator surface including pipes and domestic hot water. It is available with vitreous enamel finish with a choice of pewter to copper lustre colours.

Staff on the stand will be pleased to give information concerning the whole range of Red-Fyre Solid Fuel Appliances which are suitable for use on Local Authority Housing Contracts and in Clean Air Zones generally.

C3 **NATIONAL COAL BOARD, Hobart House, Grosvenor Place, London, S.W.1. (Telephone: BELgravia 2020).**

The National Coal Board's stand illustrates the ways in which solid fuel is contributing to the drive for clean air. On view are two Stokermatic appliances for domestic heating which operate smokelessly with bituminous coal. Also featured is an entirely new appliance ideally suited for installation in houses with only one flue and which serves both as a kitchen boiler and as a room heater in the adjacent living room. Details of mechanical stoking equipment for industrial installations are given and the Board's Housewarming Plan, Heat Investment Plan and Technical Services are also featured.

The National Society for Clean Air

Welcomes delegates and visitors to its annual conference and exhibition and invites them to call at the Conference Office and the Society's stand in the Exhibition Hall to see some of its literature, publications and exhibition material.

Stand Nos.
C.11, C.12, C.17, C.18.

NATIONAL SOCIETY FOR CLEAN AIR
Field House, Breams Buildings, London, E.C.4
Telephone: CHAncery 5038

Healthy balanced warmth throughout the whole house

Potez oil fired warm air units generate from one central point in a house a flow of warm air which circulates, by natural convection, through every room. An odourless, well balanced atmosphere prevails.

Stands A.17—A.18

POTEZ **INDUSTRIES OF IRELAND LTD.**
U. K. SALES

28-30 Orchard Street, Crawley, Sussex
Tel: Crawley (OCY3) 23188

Stand No.

C11 C12 and C18 **NATIONAL SOCIETY FOR CLEAN AIR, Field House, Breams Buildings, London, E.C.4. (Telephone: CHAncery 5038)**

Featured on the Stand are two "Do-It-Yourself" exhibition display kits which are available for sale to local authorities and other bodies wishing to publicize "Clean Air".

The first kit is called "Six Reasons for Smoke Control" and consists of six large photographs with six display cards containing the captions.

The second set is called "Why Clean Air For Me?" and again employs a combination of photographs and captions. This set is especially designed for local authorities proposing to make a Smoke Control Order and gives answers to householders' questions and objections to clean air zones.

Also on display will be a selection of the Society's display panels, photographs and literature. Copies of literature and publications can be obtained from the Society's bookstall C18 next to the Conference Office.

B12 **OIL APPLIANCE MANUFACTURERS' ASSOCIATION, Chamber of Commerce House, P.O. Box No. 360, 75 Harborne Road, Edgbaston, Birmingham, 15. (Telephone: Edgbaston 6171).**

The Oil Appliance Manufacturers' Association's stand will have on display one heater from each Association member. These heaters now qualify for grant under the Clean Air Act. The exhibit will illustrate various forms of permanent fixing required by local authorities.

The display will be backed with a comparative costs chart showing conversion and weekly running costs for gas, electrical and oil heating.

It is hoped to have available for the exhibition an O.A.M.A. safety filmstrip which is being produced for local authorities.

The remainder of the stand will contain the facts and figures of oil heater use and safety requirements.

A17 to A18 **POTEZ INDUSTRIES OF IRELAND LTD., 30 Orchard Street, Crawley, Sussex. (Telephone: Crawley 23188/9).**

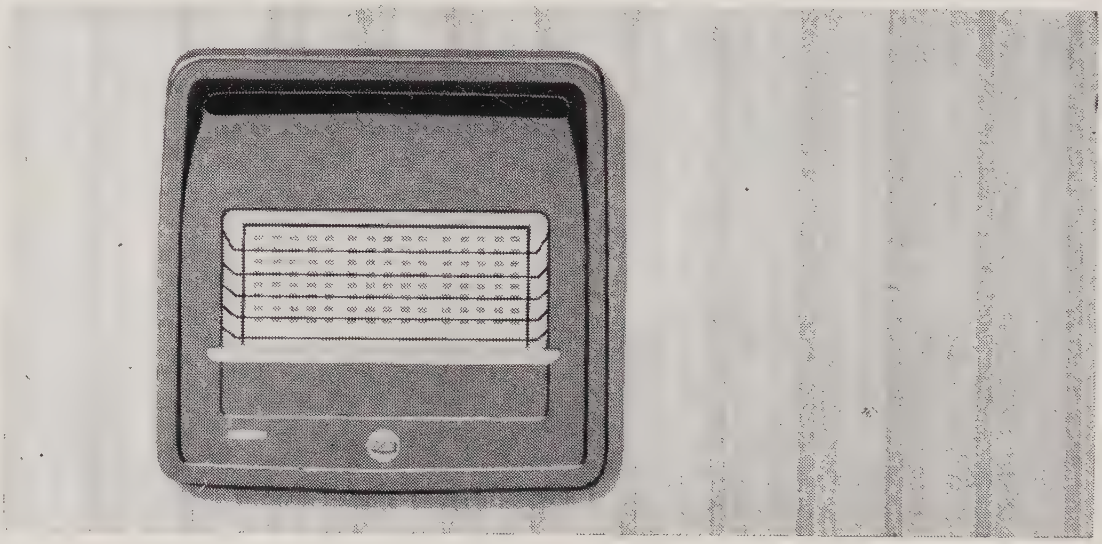
The Potez system of warm air heating offers an efficient and cheaper alternative to conventional forms of central heating.

The system is based on the use of oil-fired space heaters, which are attached to a flue and are completely odourless and safe in operation.

Potez heaters range in output from 17,000 B.T.U's to 40,000 B.T.U's per hour, and in most cases one appliance is sufficient to heat a complete house or flat. Warm air from the heater circulates throughout the rooms and maintains them at a steady temperature which can easily be regulated. In a traditional semi-detached house,

(*Entry continued overleaf*)

Save £35 per installation and come clean



At only £15.10.0 retail the Radiation BC Ten is one of the lowest priced radiant convector gas fires available for heating main living rooms and secondary rooms. Simplicity of installation makes it an excellent replacement for solid fuel fires in Smoke Control Areas. In new housing total savings of the order of £35 per installation—compared with conventional low cost solid fuel installations—can be made if the BC Ten is wall-mounted (thus dispensing with a fireplace surround and hearth) and installed with a pre-fabricated gas flue block.

The BC Ten is soundly engineered, neatly styled, has a nominal rating of 16,000 Btu/h., is equipped with press button ignition and complies with the requirements of the Clean Air Act. The legs adapt to fit high or low fireplace openings or can be removed to permit wall mounting.

Local Authority housing officials, architects, heating engineers and builders are invited to send for full particulars of the BC Ten and other Radiation gas fires, and for information on the methods and cost of installation to

Radiation Gas Fires Limited
Radiation House, North Circular Road, London, NW10

for example, a single heater can raise the living room temperature 30–35 degrees and the bedroom 20–25 degrees above the outside temperature.

The heaters can be fitted with a water coil which is attached to the existing hot water system and can produce about 80 gallons of hot water per day at very low cost.

Installation by qualified dealer, including fuel storage tank and roof insulation, can cost as little as £90 for a flat or small house, and takes only a few hours as structural alterations are seldom necessary. The installation of a water coil will cost about £10.

In large houses, multi-unit installations achieve the same results as central heating, at half the cost.

Running costs are very low, since Potez appliances use the cheapest form of domestic fuel oil at about 1s. 7d. per gallon, and the largest heater will run for an average of six hours on a gallon. In a small house, fuel consumption is only about three gallons per 24-hour day in the coldest winter weather.

A measure of the success of the Potez system is that more than one million of these heaters have been sold in Europe—where central heating is a necessity rather than a luxury, and high standards of heating are expected.

Potez distribution is now nationwide with immediate delivery.

A13 **POWELL DUFFRYN HEATING LTD., Vale Road, Camberley, Surrey. (Telephone: Camberley 3491).**

Modern smokeless fuel demands modern equipment so that the interests of fuel economy, fuel efficiency and clean air may each be satisfied. Moreover, these appliances must give the maximum of service with the minimum of complication.

Three new anthracite domestic central heating boilers that meet all the above demands are exhibited on the Powell Duffryn stand.

Jointly developed by Powell Duffryn and the National Coal Board, the three new models are of all steel construction fashioned to harmonize with modern kitchen fittings, each being only 36 in. high. All operate by natural draught requiring no fans and hence no electrical connections. For fuel economy the new Powell Duffryn boilers have been designed specifically to get the best out of anthracite beans—the size that never wastes away as dust, is easiest to handle and always in plentiful supply. The fire-bed remains at constant depth for maximum fuel economy. A newly developed, non-electric thermostat damper control eliminates heat wastage.

(*Entry continued overleaf*)

see Parkray on stand B13

Special Central Heating Display: Local Authorities and developers all over the country are using Parkray room heaters in smoke control areas to take advantage of the most freely available smokeless fuels. There are fully documented and costed case histories showing how Parkray room heaters have been used to provide central heating on the lines recommended in the Parker Morris Report.

Full details of:

Parkray open fire behind glass

are obtainable from **RADIATION PARKRAY LTD**
RADIATION HOUSE · NORTH CIRCULAR ROAD
LONDON, N.W.10 · TEL: WILLESDEN 1234

A RADIATION PRODUCT

Gravity fed, the large built-in hopper requires filling only once a day for full central heating and only twice a week for hot water or background heating. The ash becomes a hard brick requiring removal only every day or two. There is no raking. No dust.

Full specification and technical data for the new models can be obtained from Powell Duffryn Heating Ltd., Camberley, Surrey. The new boilers are the A-40, A-60 and A-80 with ratings of 40,000, 60,000 and 80,000 Btu/h respectively.

Also on view at the Powell Duffryn stand are the new miniaturized Housewarmer fan-operated warm air units. These make possible for the first time the connection of warm air to solid fuel fired boilers.

For new houses, the Powell Duffryn gas-fired ducted warm air units will be shown, and for all hot-water types of central heating, the very well-known panel radiators, H.E. radiators and Corru-rad radiators will be on view.

All equipment exhibited may also be seen at the Heating Advisory Centre, 229 Regent Street, London, W.1.

A23 PYRAMID PRESS LTD., Publicity House, 41 Streatham Hill, London, S.W.2. (Telephone: TULse Hill 1222 (9 lines)).

The publications to be found on our book stand were produced free of all cost for various local authorities and they deal particularly with Clean Air Zones.

The publications are designed to be used by Public Health Inspectors when they are conducting their clean air campaigns and they are both informative and interesting to members of the public.

Our representative at the stand will be able to assist you in any queries you have regarding these publications.

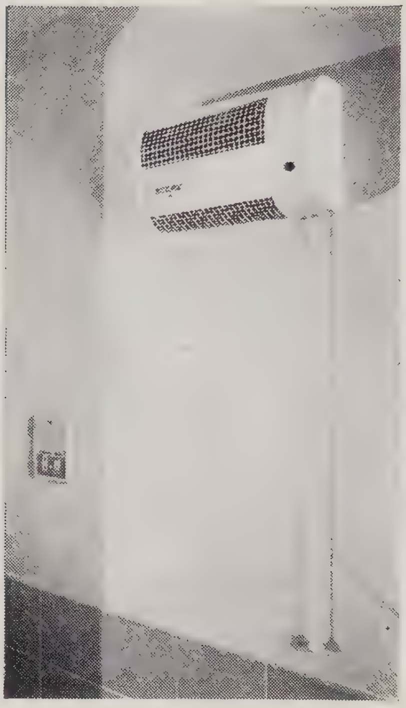
B13 RADIATION LIMITED, Radiation House, North Circular Road, London, N.W.10. (Telephone: WILlesden 1234).

All appliances produced by the Radiation group are clean air appliances. At this Exhibition gas and solid fuel equipment for domestic room heating, water heating and central heating are shown.

Solid fuel appliances of particular interest for Clean Air Zone applications are the PARKRAY "open fire behind glass" room heaters, including the Parkray 77 with high output back boiler which many Local Authorities are specifying to provide central

(Entry continued overleaf)

MODERN HEATERS and EXTRACTOR FANS



buy sager

TOP LEFT:
The 'MAYFAIR'. Dispel cooking odours and reduce condensation in kitchen or bathroom with the Sager Extractor Fan.

TOP RIGHT:
The 'HI-FLOW' Wall Heater. Elegant in design, extremely efficient, this heater is easily installed and gives complete safety in any bathroom or kitchen.

BOTTOM RIGHT:
The 'KNIGHTSBRIDGE' MH4. Modern in design, this fan heater with 1 or 2 kW heating, cold air for summer use, and a built-in time switch, is a must in any home.

Full details from:

SAGER LIMITED

ORCHARD HOUSE, POTTERS BAR, MIDDLESEX.
or Telephone: HILLSIDE 8354

heating service in both new housing and replacement projects. Other Parkray products include independent boilers, back boiler flue sets and Clean Air inset fires.

The phenomenal growth in the past few years of the popularity of the modern gas fire with the general public is now beginning to be reflected in Local Authority housing, especially with authorities implementing the provisions of the Clean Air Act. RADIATION Gas Fires Limited demonstrate on the stand the widest range of gas fires in price, performance and flexibility of installation available in the U.K.

RADIATION Central Heating Units provide a background or full heating in homes with from 2 to 4 bedrooms. They are completely automatic, take up very little room. Clean Ductair gives you the luxury of a home that's always warm, fresh as a daisy on amazingly little gas.

ASCOT Gas Water Heaters, Instantaneous and Storage, can supply your home with piping hot water, using a minimum of gas. There is no system that is cleaner or more convenient. All the Ascot high output heaters are equipped with standard safety devices and are built to give long service with the minimum maintenance.

B27 ROBOPHONE LIMITED, 179 Tottenham Court Road, London, W.1. (Telephone: MUSeum 5687).

From the Robophone Range of Automatic Telephone-Answering and Recording equipment, the two models demonstrated will be the Secretary, and the revolutionary new RECALLER.

The Secretary, with dual changeable answering announcements, three hour recording capacity and complete dictation facilities is installed for the reception of telephone messages for all delegates to the 31st Annual Conference of the National Society for Clean Air.

The RECALLER, identical in all other respects with the Secretary, enables its user to receive, from any remote telephone, all messages recorded in his absence, with perfect security.

B6 SAGER LTD., Orchard House, Potters Bar, Middlesex. (Telephone: Potters Bar 57121).

Examples of Sager tangential flow fan heaters—the "Knightsbridge" and the "High Flow"—and the "Mayfair" extractor fans are on display. These are suitable for both homes and offices, either as a complete central heating system with time and thermostatic controls or as individual units.

OIL?

FOR INDUSTRY CLEAN AIR compliance faces industry with many problems, commercially as well as socially. Oil-Firing can solve them, efficiently, economically and advantageously. Shell-Mex and B.P. Ltd not only supply this cleanly capable fuel but also offer a service. A service embracing every facet of oil's application and handling and storage. A service that is unsurpassed in experience and resources and which extends all the co-operation and advice that local authorities may require.

FOR THE HOME Here, too, oil has an answer to every problem. From full central heating to the cheapest home heating of all, paraffin heaters, there is a variety of ways to comply with the Clean Air Act and to suit everyone's need and budget.

On all matters concerning oil-firing and clean air, you are invited to make full and free use of Shell-Mex and B.P. service. This assistance can be obtained from a Shell-Mex and B.P. Industrial Fuels, or Domestic Fuels Superintendent —on request to the divisional office in your area or to head office in London.

SHELL-MEX AND B.P. LTD SHELL-MEX HOUSE
STRAND LONDON WC2 TEMple Bar 1234

SHELL

BP

Stand No.

C15 SANIGUARD APPLIANCES LTD., Fowler Road, Hainault, Essex. (Telephone: Hainault 4111-2-3).

The Barrywald Safety Sanitary Incinerator has now been displayed at all of the Public Works and Municipal Services Congresses and Exhibitions since the war in its various forms and has won high acclaim from many thousands of different establishments for the improvements in hygiene achieved for its intended purpose.

Newest developments have produced a higher rate of disposal for a lesser running cost thus making this appliance more attractive from every point of view.

The electrical loading is now set at 1 kW. and all components are fully guaranteed for one year and the appliance is backed up by a fully confident service organization which can carry out its efficient activity in all parts of the country.

The size of the Barrywald Incinerator is now 19 in. by 18 in. by 10 in. and its weight is approximately 50 lb. For new applications and advice regarding the installation, which is a simple matter under normal circumstances, please enquire at our stand.

Also displayed—Eldorite Mineral Wool insulation material.

A3 SHELL-MEX AND B.P. LTD., Shell-Mex House, Strand, London, W.C.2. (Telephone: TEMple Bar 1234).

Shell-Mex and B.P. Ltd. will again be represented by a display embracing both domestic and industrial fuels interests. The emphasis this year is conveyed by the phrase "Forward with Oil".

Domestic fuels section of the stand will demonstrate the ability of the Company's domestic oil fuel and associated services to meet the requirements of householders who require simple conversion to smokeless fuels, also those householders who wish to take advantage of the contributory grant to improve their standards of heating at the time of conversion. A flue-less oil heater presented as a typical fireplace conversion, will form part of the exhibit and this will provide part heating for the stand.

The industrial section of the stand will consist of a display of some of the equipment used by the Company when investigating the performance of oil burning equipment. Technical staff will be available to discuss the techniques involved and significance of results.

C2 SOLID SMOKELESS FUELS FEDERATION, 74 Grosvenor Street, London, W.1. (Telephone: MAYfair 3327/8).

The Federation's stand for 1964 is designed to play two roles.

In line with the policy of the Federation to provide a non-commercial advisory service to delegates, one purpose of the stand

(*Entry continued overleaf*)

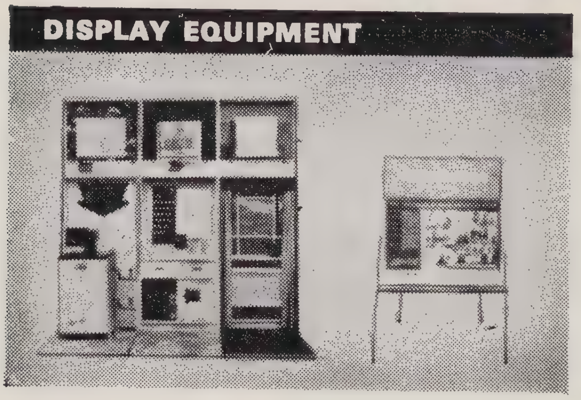
SSFF

SERVICE TO LOCAL AUTHORITIES PROMOTING

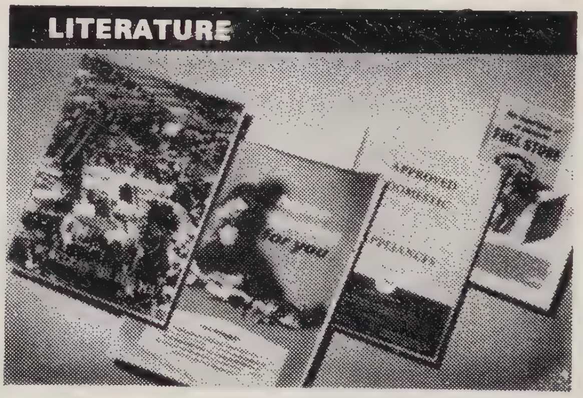
CLEAN AIR

STATIC EXHIBITIONS

MOBILE EXHIBITION UNITS

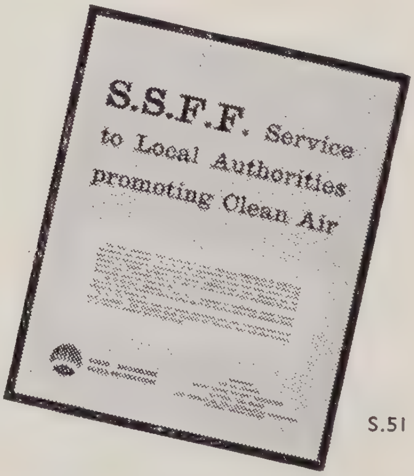


DISPLAY EQUIPMENT



LITERATURE

Local Authorities establishing Smoke Control Areas or organising "Clean Air" campaigns, House Improvement or Conversion schemes should take full advantage of the technical advice and assistance offered free of charge by the Federation. During the past year 161 Local Authorities up and down the country were assisted with the Federation's static and mobile exhibitions, 22 Local Authorities made use of portable display equipment; and more than 200,000 copies of the booklet *Clean Air for You* (now being revised) were supplied for distribution.



S.S.F.F. Service to Local Authorities promoting Clean Air

S.51

Copies of a new publication describing and illustrating the service will be supplied on application to:

SOLID SMOKELESS FUELS FEDERATION, 74 GROSVENOR STREET LONDON W.1.

will be to display to visitors a range of modern solid fuel heating appliances and information panels relating to the average costs of installations and conversions, fuel availability, central heating, etc. Three appliances will be under fire, an underfloor draught open fire, an inset room heater and a free standing room heater, these will be burning fuels in good supply throughout the country.

The other purpose of the Federation's stand is to introduce to local authority officers the comprehensive display of fuels, appliances and methods of ignition, information panels, etc. that can be provided, free of charge, to local authorities for use in exhibitions, whether in halls or marquees.

Other items can be added to the exhibits where information relating to house improvement grants and conversions is required.

A16 THERMODARE (GREAT BRITAIN), Unidare House, Hayes End Road, Hayes, Middlesex. (Telephone: HAYes 8371).

Taking full advantage of fourteen years' experience in the manufacture of Night Storage Heaters, Thermodare are exhibiting selected units from the Renoir, Rembrandt, Rubens ranges which have been designed to offer a highly efficient form of central heating with a choice of style and colour to suit the decor of any home.

This concept of Night Storage Heating was introduced by Thermodare to combat condensation problems and ensure that building fabric is maintained in good condition. It has the added advantage that decorations deteriorate far less than with the conventional systems and low capital costs (installation costs approximately half the cost of other systems) can be coupled with economical running costs and evenly maintained temperatures.

All Thermodare heaters are equipped with the exclusive five position thermostat switch (Patent No. 842,000), which enables them to be regulated appropriate to seasonal weather variations and further protected by a fusible safety link (Patent No. 833,995) which affords complete protection and eliminates any fire risk.

All heaters in the Renoir and Rembrandt ranges are suitably packaged for site assembly, but can, if required, as an optional extra be delivered direct to site ready for immediate connection. Prices are as follows:

RENOIR and REMBRANDT	1½ kW.	£18 10s.
RENOIR and REMBRANDT	2¼ kW.	£21 10s.
RENOIR and REMBRANDT	3 kW.	£26 10s.

For those who prefer to keep to the pattern of the now well proven DV.25 (the original Domestic heater) the latest version known as the Rubens range (factory built units) may well be their choice. Prices are as follows:

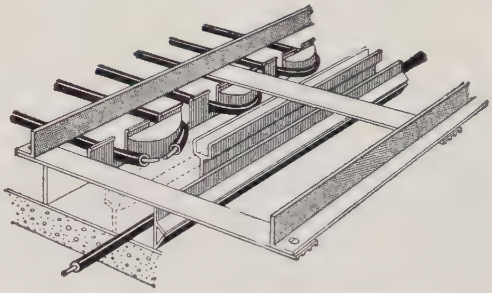
RUBENS	1½ kW.	£19 9s.
RUBENS (vertical)	2½ kW.	£21 10s.
RUBENS (horizontal)	2½ kW.	£23 0s.

(*Entry continued overleaf*)

THERMODARE
originators of electric night storage heating

NIGHT STORAGE HEATING
pioneered and perfected by Thermodare

1 Avoidance of condensation.
2 Building fabric is maintained in good condition.
3 Decorations remain unimpaired.
4 Simplified costing: tenants can pay running costs individually or by apportionment.
5 Low capital and installation costs (installation costs alone are half that of conventional systems).
6 Thermodare units are standardised.
7 Temperature is maintained evenly and constantly.
8 Running costs are economical.
9 The first-rate functional design and styling harmonise with individual colour schemes and decor.



WARM FLOOR HEATING

Rewireable or embedded underfloor electric heating systems are adaptable to meet individual building requirements.

USE THE THERMODARE TECHNICAL SERVICE

Thermodare design engineers will be pleased to prepare quotations for any project which you may have in mind.

The sign of Good Heating THERMODARE

THERMODARE

Thermodare (Great Britain),
Unidare House, Hayes End Road,
Hayes, Middlesex.
Telephone: Hayes 8371

To meet the two-fold requirements of:

(i) a continuous daytime output to maintain background warmth, and

(ii) facility to boost the room temperature by switching on the fan which provides additional flow of warm air when normally required, say from 6 p.m. onwards.

the Model DFA.25 2½ kW. Fan Assisted Heater has been developed —Price: £37 10s.

For further details of all products, including Infra-Red and Warm Floor Heating, please visit us on STAND No. A16.

A5 **THERMOTANK LTD., 150 Helen Street, Govan, Glasgow, S.W.1. (Telephone: Govan 2444).**

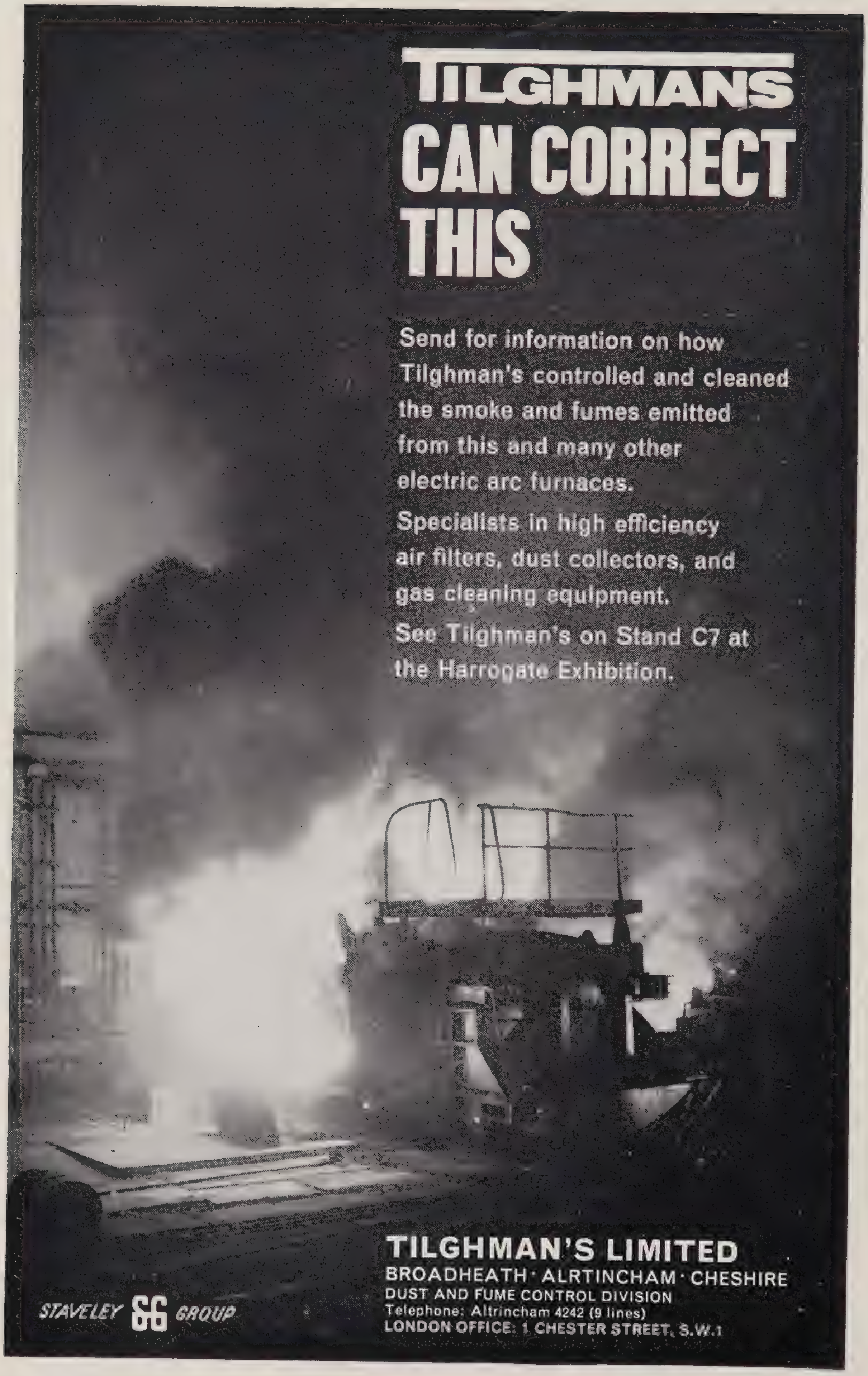
The main feature of the Thermotank stand at the exhibition is a model of the Dribore chimney. The essential features of Dribore construction for chimneys and ducting comprise firstly, a double skin and secondly, enclosed insulation. The thickness of the mild steel employed for the inner and outer skins varies with the diameter of chimney or flue from 12 gauge for chimneys up to 14 in. diameter up to $\frac{3}{16}$ in. thick for the largest chimneys.

The stayed double skin gives greater structural strength than ordinary forms of construction in equivalent sizes and since wastage due to condensation is virtually eliminated, the structural strength is maintained over much longer periods. Chimneys and ducting are made in sections up to 15 ft. long which are usually joined by means of flanges on the inner and outer skins, both projecting externally and insulated one from the other to avoid local heat losses. These flanges are welded in position and form a rigid bolted connection. Differential expansion between the two tubes is taken up in the design of the inner flange which permits the inner skin to expand without undue stress being set up.

The insulation value of the construction lies in the sealed air and in the corrugated aluminium foil which is inserted into the $\frac{5}{8}$ in. air gap between the inner and outer walls during construction and which provides four highly reflective surfaces to reduce radiation losses to a negligible amount.

Convection losses are minimized by dividing the annular space longitudinally into sections not more than 2 ft. long with fibrous insulation and so restrict circulation in the air gap. Since still air is one of the best heat insulators, the conduction losses are very small due to the double-skinned construction and the temperature gradient through the composite wall of the flue or chimney is such that the inner skin is maintained at the highest possible temperature relative to the flue gases.

(*Entry continued overleaf*)



Send for information on how Tilghman's controlled and cleaned the smoke and fumes emitted from this and many other electric arc furnaces.

Specialists in high efficiency air filters, dust collectors, and gas cleaning equipment.

See Tilghman's on Stand C7 at the Harrogate Exhibition.

STAVELEY SG GROUP

TILGHMAN'S LIMITED
BROADHEATH · ALRTINCHAM · CHESHIRE
DUST AND FUME CONTROL DIVISION
Telephone: Altrincham 4242 (9 lines)
LONDON OFFICE: 1 CHESTER STREET, S.W.1

DF9

Stand No.

The advantages of Dribore construction are that the inner skin temperatures on the Dribore chimney are consistently above the temperature at which severe corrosion takes place (230°F.) whereas, in an unshielded chimney severe corrosion takes place due to acid condensation at ambient temperatures in excess of 80°F. unless adequate measures are taken to maintain the metal temperature.

In addition to the model Dribore chimney on show at the Thermotank stand, there are also displayed other products in the Thermotank range, equally suitable in their own sphere for solving the problems associated with air treatment.

C7 TILGHMAN'S LIMITED, Broadheath, Altrincham, Cheshire. (Telephone: Altrincham 4242).

Tilghman's Dust and Fume Control Division specialize in high efficiency air cleaning and gas cleaning equipment and at this exhibition a special feature will be a display panel illustrating the principle of the Tilghman low and high temperature automatic fabric filter plant suitable for continuous operation as used in the chemical, steel, foundry, rubber and many other industries where high efficiency dust collection is required for long periods of continuous operation without requiring a plant shut down.

Tilghman's have also recently added to their range, the Walther multi-tubular mechanical collectors and industrial electrostatic precipitators and at this exhibition a comprehensive booklet will be available for the first time giving full description of these products. Walther equipment has been used for many years on the Continent to clean exhaust gases and in particular the fumes emitted from boiler plants on power generating stations, cement kilns and public refuse incinerators, etc.

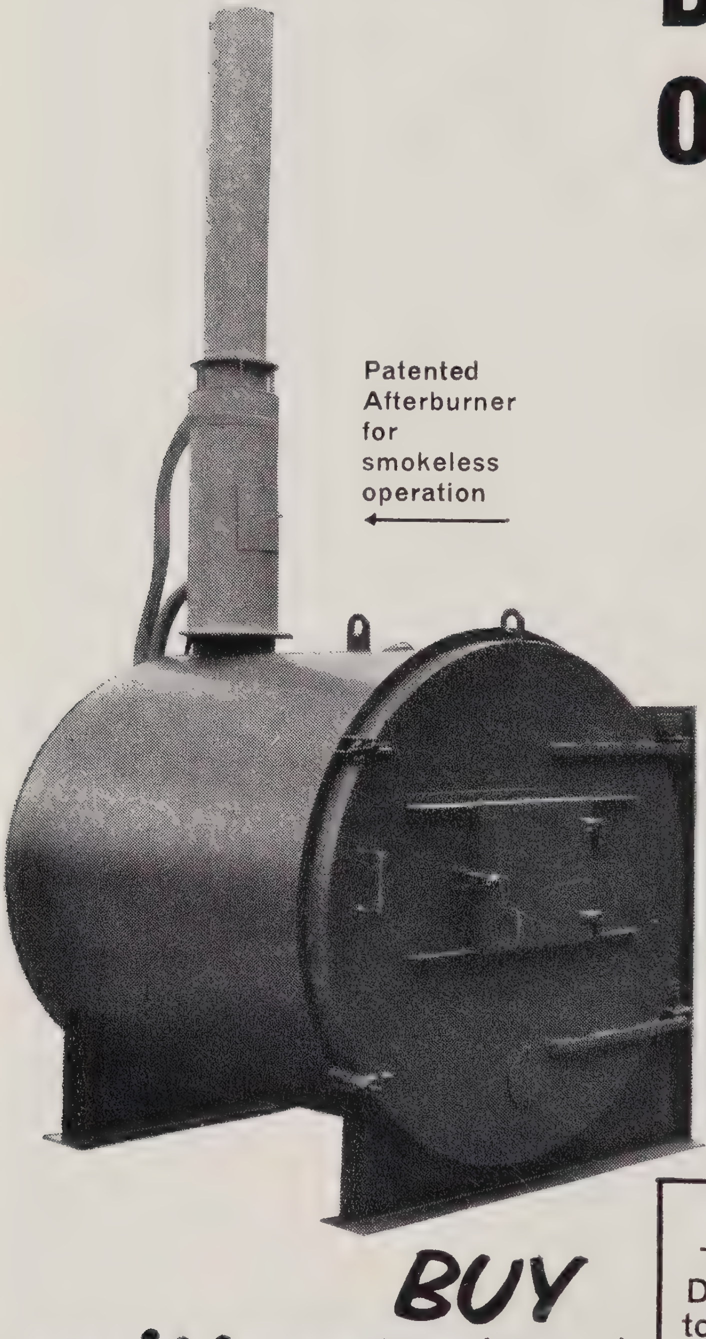
Full details will also be available of the range of Tilghman high efficiency filters for cleaning atmospheric air for offices, hospitals, sewage plants and other industrial applications.

B28 T.V. STORY-BOARD COMPETITION

Opposite this stand are displayed about 50 T.V. Story-boards which have been selected from the hundreds submitted by children within a 25 mile radius of Leeds. A Story-board is the working plan used for television commercial announcements and gives details of what the viewer will see and hear during transmission. The children were asked to tell viewers the advantages of clean air, the danger and discomfort of atmospheric pollution caused by such things as smoke from house chimneys and factories,

(*Entry continued overleaf*)

FOR *REALLY* SMOKELESS DISPOSAL OF REFUSE



see the
PATENTED
SEALED FLAME
SMOKELESS
DISPOSAL UNITS

on STAND
B5

working demonstrations
on outside Sites 1 & 2

No grates to burn out or
clog. Entire front opens
to admit largest refuse.
NO SMOKE. ODOUR.
GRIT. FLY ASH.

WRITTEN GUARANTEE
The Patented Sealed Flame
Disposal Units are guaranteed
to fully meet the requirements
and provisions of
LOCAL AUTHORITY
REGULATIONS
and
THE CLEAN AIR ACT

BUY without risk!

SIZES TO SUIT ALL REQUIREMENTS

Sole Licencees

UNIVERSAL MACHINERY & SERVICES LTD.
VICEROY WORKS, LOW FIELDS ROAD, LEEDS 12. Tel: LEEDS 34261/2/3

dust, grit and fumes, and/or the comfort and benefits to the housewife and her family of modern smokeless heating methods.

Visitors to the Exhibition, including Conference delegates are invited to pick out what they consider to be the best ten Storyboards and place them in order of merit. Originality and methods of presentation are more important than artistic skill. Prizes will be awarded to competitors whose entry is nearest to the final selection by the panel of judges. Full details and rules are given on page 102 of this Handbook, together with a complete list of prizes to be awarded. On this stand can be seen some of these prizes.

Entries must be submitted on the official entry forms obtainable from this stand. These must be deposited in the box provided not later than 5 p.m. on Thursday, 22nd October.

B5 and outside Demonstration Site **UNIVERSAL MACHINERY & SERVICES LTD., Viceroy Works, Low Fields Road, Leeds, 12. (Telephone: Leeds 34261/3).**

Universal Machinery & Services Ltd. introduce the new Sealed Flame Disposal Unit for absolutely smokeless disposal of any type of refuse. The principle on which it works renders obsolete former principles of combustion. There are no fire bars or grates to hinder combustion and burn out. It has no through draught but works on the principle of rear driven forced draught through air tubes located in the bottom of a curved hearth. Nothing can lie flat. The refuse is contained in a cocoon of air and burns right through. It will dispose quite smokelessly of any type of refuse, including rubber, plastics, animal, vegetable—anything.

Because the whole front opens it obviates the need to employ labour for breaking up and feeding. It takes all types and sizes of refuse as it comes in a single loading operation with unskilled labour; seconds to switch on and light off and the operator is released for useful duties until the next loading as the Sealed Flame Unit takes care of it all by itself. Although completely smokeless there is no gas consumption in the furnace. The patented construction causes the refuse to generate its own gases in a perfect cocoon of air.

The patented stack consists of a double sleeve, that is an inner and outer member, incorporating in the design a mixing chamber which converts the highly pre-heated smoke/air mixture into a gas which is ready for instant ignition. That is why the patented Afterburner sparks off this combustible mixture with such negligible gas consumption. Why is the double sleeve stack/mixing chamber design essential to complete smoke elimination? The answer is that where an Afterburner is applied through a single stack member, it is trying to burn neat smoke from the furnace, or at best, smoke

(*Entry continued overleaf*)

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National Industrial Fuel Efficiency Service

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LONDON W1

Telephone: Hyde Park 9706

to which cold air has been introduced through the ash-pit or through the stack. This lowers the temperature of the smoke, detracting from combustion. Such an Afterburner through a single stack member even with its heavy consumption of gas, cannot achieve proper elimination. With the patented inner and outer stack member design (Patent No. 930,324) once the refractory of the mixing chamber is hot, the Sealed Flame Chamber will operate smokelessly for long periods with no gas consumption at all. That is the difference.

The Sealed Flame principle entirely eliminates fire hazards, burning refuse is entirely isolated in the chamber. No dirty, open ash-pit with through draught carrying smoke, grit and fly ash into the atmosphere. There is positively no air pollution at either stack or ground level.

Maintenance costs are negligible as there are no fire grates to renew and no costly future dismantling for replacing refractory.

The makers give a written guarantee that it will smokelessly incinerate any type or mixture of refuse, wet, dry or both, with an unskilled operator and that it will more than comply with the provisions of the Clean Air Act. Its unique features are fully protected under many British and Foreign Patents and Registrations of Design.

At the Exhibition, visitors will have the opportunity of seeing every type of problem refuse incinerated entirely without smoke from beginning to end. The same principle of perfect combustion is later to be applied to heating and steam boilers which will be able to burn cheap fuels of low calorific grades efficiently and smokelessly.

C5 THE WEST RIDING CLEAN AIR ADVISORY COUNCIL, Public Health Department, 25 East Parade, Leeds, 1. (Telephone: 3-0661).

The history of this Council dates back to 1925 following the Report of the Departmental Committee on Smoke Prevention issued in 1921 which, *inter alia*, recommended that regional advisory committees be established. On May 15, 1925, a conference of local authorities in the West Riding was held at the Town Hall, Leeds, to discuss the formation of a regional committee and as a result of this conference the West Riding of Yorkshire Regional Smoke Abatement Committee was inaugurated and on the same day an Executive Committee was appointed and held its first meeting.

With the passing of the Public Health (Smoke Abatement) Act, 1926, local authorities were given additional powers and responsibilities, *e.g.*, power to make smoke by-laws, and the Regional Committee by introducing uniformity and co-operation between the constituent local authorities exercised a powerful influence in

(Entry continued overleaf)

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Heat is our business

and

CLEAN AIR

is our

business too

OUR AIM: MAXIMUM EFFICIENCY . . . SMOKELESS COMBUSTION

Charringtons will gladly help you to meet the demands of the Clean Air Act. Our Technical Experts are always at your service to advise on domestic and industrial fuel problems. Ensure efficient smokeless combustion—consult Charringtons.

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CHARRINGTON, GARDNER
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promoting measures designed to eliminate atmospheric pollution.

In 1955 the boundaries of the area served by the Committee were extended to cover the whole of the West Riding (excluding Sheffield) and subsequently the number of constituent local authorities was increased to 84 comprising the following groups:

West Riding County Council
10 County Boroughs.
12 Municipal Boroughs.
50 Urban Districts.
11 Rural Districts.

In view of the increase in membership and the passing of the Clean Air Act, 1956 it was decided that the Constitution should be reviewed and brought up to date and on February 21, 1957, at a special general meeting held in Leeds a new Constitution was approved and the name of the Committee was changed to "The West Riding Clean Air Advisory Council" which was considered more appropriate to the new outlook.

The main objects of the Council are as follows:

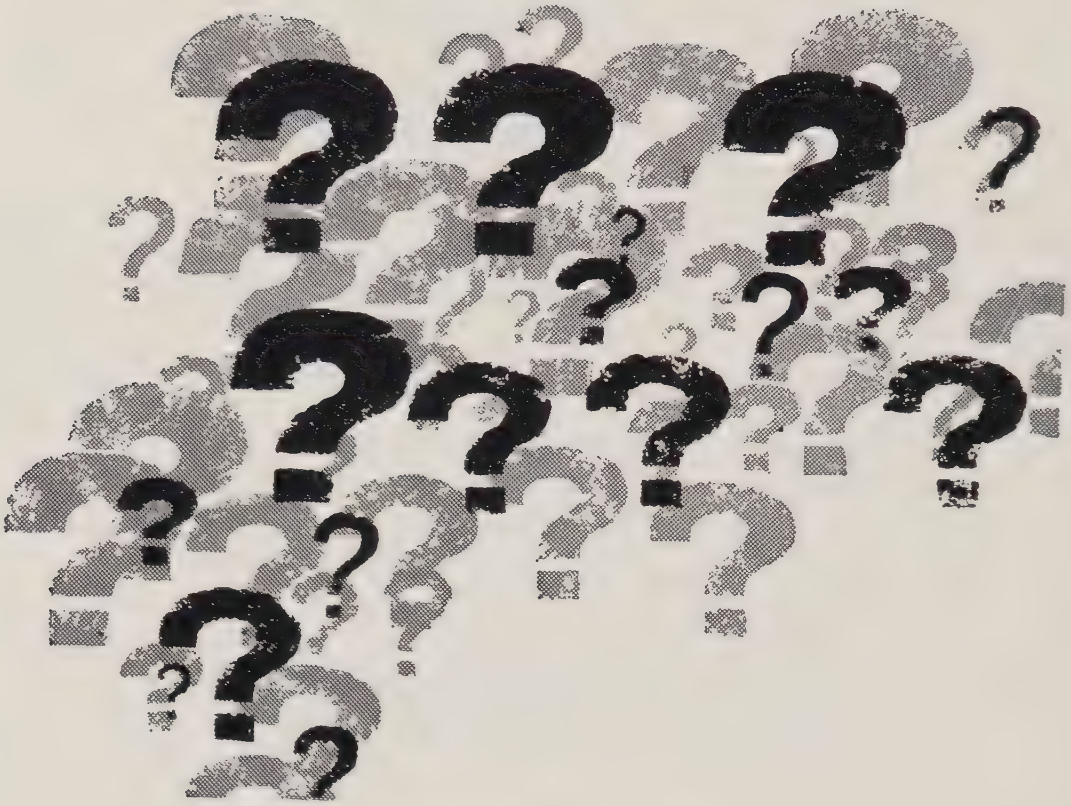
(*a*) To consider all matters relating to Atmospheric Pollution.
(*b*) To secure a better understanding between local authorities, industry, and the general public.
(*c*) To arrange for the provision of information on Atmospheric Pollution to industry and the general public.
(*d*) To keep in touch with all other bodies, National and Local, and with Government Departments engaged in prevention of atmospheric pollution and to collect all information relating to the latest developments in apparatus and appliances for that purpose.
(*e*) In consultation with the various education authorities to organize courses of training for stokers and boiler attendants throughout the area and to encourage the holding of examinations in suitable centres.
(*f*) To make available advice on matters of law and practice relating to atmospheric pollution.

A10 THE WOMEN'S ADVISORY COUNCIL ON SOLID FUEL, 18 South Molton Street, London, W.1. (Telephone: MAYfair 5358/59/60).

The Council has recently celebrated its 21st birthday and was congratulated on its achievements by the Minister of Power and by Lord Robens. It continues its work in bringing to the housewife the latest developments in improved solid fuel burning appliances for space heating, cooking and domestic hot water supplies, as well as in the use of the correct and most economical solid fuel. Composed of representatives of women's organizations, those

(*Entry continued overleaf*)

which air cleaning system?



Call in the specialists **HEAD WRIGHTSON GAS CLEANING**

Whatever your air cleaning problem – dust removal in industrial processes or air conditioning plant – Head Wrightson supply the answer.

The service provides advice, design and the installation of a system complying with the Clean Air Act, costing as little as possible. Head Wrightson have available a complete range of equipment, filters, scrubbers, precipitators, cyclones and an efficient after-sales service.

Head Wrightson Iron & Steel Works Engineering Limited,
Thornaby-on-Tees, Yorkshire. Telephone: Stockton 62241

TW 248

concerned with education and housing, public health authorities and other interested bodies, the Council's work is furthered in the regions by the Scottish Committee and fourteen Regional Committees in England and Wales composed of voluntary members who give their time to support and extend the work of the staff both regionally and at Headquarters.

The Regional Organizers cover a comprehensive field of work which includes lecturing to students in colleges and schools, giving talks covering subjects such as Clean Air, Standard and Discretionary Grants, all forms of heating by solid fuel, cookery, insulation, and other allied subjects. Afternoon Meetings to which interested parties are invited are arranged as well as Training Courses. The latter can be arranged in conjunction with any local authority wishing for further education of staff, and mass demonstrations can be given for them on Housing Estates, or to elderly people, on the correct use of appliances.

The Council constantly extends its services and in addition to The Proficiency Certificate on the Domestic Use of Solid Fuel available for students in home economics and others, for whom the textbook *The Modern Use of Solid Fuel* has recently been published, the Council provides a cookery service both for demonstrations in schools and for Exhibition work in the main Agricultural Shows.

The North Eastern Regional Committee whose Headquarters are in Leeds, is holding a Conference in connection with the Exhibition and will bring many invited guests to tour the stands. They are arranging also to bring parties of women's organizations, who will see the cookery demonstrations which their staff are giving on Stand No. A10 when the theme will be "Autumnal and Hallowe'en Cookery". Demonstrations every hour, on the hour.

Further information and literature may be obtained from the General Secretary, 18 South Molton Street, London, W.1.

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Exhibition • Press • Industrial Photographs

**STAND
C. 11**

"Select the Ten Best T.V. Story-boards" Competition

(See display in the Exhibition Hall and on Stand No. B.28)

FIRST PRIZE

One week's holiday for winner and family in Belgium in 1965 as guests of the Belgian National Tourist Office, the Belgian Marine, Blankenberghe Municipality and the Casino of Blankenberghe. Hotel accommodation and full board will be provided at the seaside town of Blankenberghe and during the week, the family will be guests of honour at a dinner given by the directors of the Casino, offered free entrance to the Ballroom, the "Hit Club" and the Night Club and provided with seats for all gala performances in the Great Hall.

plus

EITHER: 45,000 Btu "Hotspur" oil-fired domestic boiler,
or a Radiation "Highspeed G" gas room heater,
or a Parkray "33" solid fuel room heater with heat-resisting glass door,
or one unit-plan off-peak electric night storage heater installed complete,
or a Baxi patent underfloor draught fire, plus installation costs up to £10.

plus

One ton of "REXCO" smokeless coal or Barnsley BurnBrite smokeless fuel, together with an electric fire lighter.

plus

£20 cash.

plus

Four bottles of Henkell sparkling wines—(Trocken, Rosé, Kardinal Burgundy, Brut Vintage).

plus

Set of nine Pan paper-back editions of Ian Fleming's James Bond thrillers.

plus

A box at Billy Smart's Christmas Circus at Leeds.

plus

Tickets to an A.B.C. Television show at the Manchester Studios.

plus

A book: *The Modern Use of Solid Fuel —a Study in Domestic Heat Services*, by Kathleen V. Bradbury.

plus

A book: *Guide to Britain.*

SECOND, THIRD, FOURTH and FIFTH PRIZES

EITHER: "Hotspur" boiler; Radiation gas room heater; Parkray "33" room heater; electric unit plan heater. *or* Baxi fire (depending on the choice of the First Prize and subsequent winners).

plus

Tickets to an A.B.C. Television Show.

plus

Book: *Guide to Britain.*

plus

"Morny Toilet Soap" gift pack.

SIXTH, SEVENTH, EIGHTH and NINTH PRIZES

Choice of (*a*) Goblin "Teasmade de luxe" electric automatic tea maker; (*b*) a Goblin "R.H.2" domestic air conditioner unit; (*c*) a "Warmwave 50" infra-red electric heater; (*d*) a Universal "U2" electric wall towel rail; *OR* (*e*) an electric immersion water heater, installed complete.

TENTH PRIZE

"Tudor Knight" stainless steel fruit bowl.

CONSOLATION PRIZES—*Guides to Britain* books; Morny Toilet Soap.

COMPETITION RULES

1. Competition is open to all visitors including Conference delegates and members of the general public to the National Clean Air, Fuel Efficiency & Domestic Heating Exhibition at Harrogate on Tuesday, Wednesday and Thursday, October 20, 21 and 22, 1964.

2. Competitors are required to select the best ten "Story-Boards" displayed in the Exhibition Hall and place them in order of merit. A "story-board" is the working plan used for television commercial announcements and gives details of what the viewer will see and hear during transmission. Entries have been submitted by schoolchildren within 25 miles of Leeds who were asked to tell viewers the advantages of clean air, the danger and discomfort of atmospheric pollution caused by such things as smoke from house chimneys and factories, dust, grit and fumes, and/or the comfort and benefits to the housewife and her family of modern, smokeless heating methods.

In selecting the best ten, consideration should be given to simplicity and originality and the idea and methods of presentation should count far more than artistic skill.

3. Competitors must enter the numbers of the "story-boards" in correct order of merit on the special entry form obtainable in the Exhibition Hall. Each entry must bear the contestant's name, address and if possible, telephone number. **Only one entry per visitor will be permitted.**

4. The Competition closes at **5 p.m.** on **Thursday, October 22,** and it is hoped that it may be possible to announce the winners from the stage of the Harrogate Opera House during the evening's performance on October 22. All winners will receive notification by post.

5. The winner will be the competitor whose ten selections are nearest to the final selection made by the panel of judges. Prizes will be awarded for runners-up in order of merit.

6. In the event of a tie, the winners will be selected by drawing lots.

7. Officers and staff of the National Society for Clean Air are ineligible to enter.

8. The judges' decisions will be final and no correspondence relating thereto will be allowed.

ACKNOWLEDGMENTS

The National Society for Clean Air wish to thank the undermentioned exhibitors and friends for their contributions to the prize lists for the TV story-board competition.

A.B.C. Television Ltd.
Barnsley & District Coking Co. Ltd.
Richard Baxendale & Sons Ltd.
Belgian National Tourist Board.
Belgian Railways and Marine.
Municipality of Blankenberghe.
Casino of Blankenberghe.
B.S.A. Harford Pumps Ltd.
Sir Billy Butlin.
B.V.C. (Goblin) Ltd.
Central Electricity Generating Board.
Coal Utilisation Council.
Electrical Development Association.
Mr. Charles Forte.
Grand Metropolitan Hotels Ltd.
Henkell (London) Ltd.
Lucas Industrial Equipment Ltd.
Messrs. Bernard & Cyril Mills.
Morny Ltd.
National Carbonising Co. Ltd.
National Coal Board.
George Newnes Ltd.
N.E. Gas Board.
Odhams Press Ltd.
Oil Appliances Manufacturers Association (OAMA).
Pan Books Ltd.
Parker Pen Co. Ltd.
Powell Duffryn Heating Ltd.
Radiation Parkray Ltd.
Sheaffer Pen Co. (England) Ltd.
Shell-Mex & B.P. Ltd.
Mr. Billy Smart.
Thermodare (Great Britain).
Yorkshire Electricity Board.

Top value in home heating

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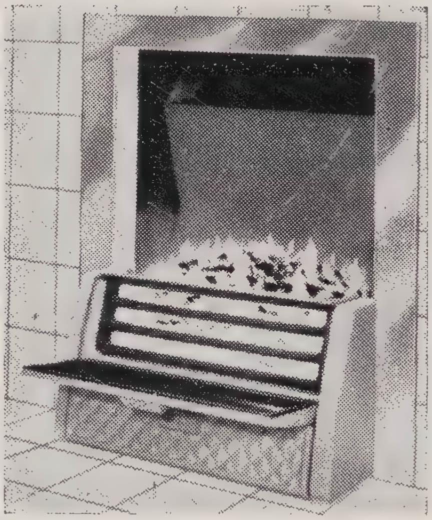

LOFIRE MODEL 'A'

This popular continuous burning fire is ideal for smoke control areas. From as little as **71s. 9d.**

LOFIRE DROP-FRONT

A continuous burning fire with a drop-front to increase heat radiation. From **106s. 9d.**

Other approved 'LOFIRE' appliances include the Lofire Home Heater, the Lofire Home Heater 105, the Lofire Underdraught Fire, the Lofire Model AB, and the Lofire Convector Mark 3. Post the coupon below today for full details.

All these models are approved by the Coal Utilisation Council and the Domestic Solid Fuel Appliances Council

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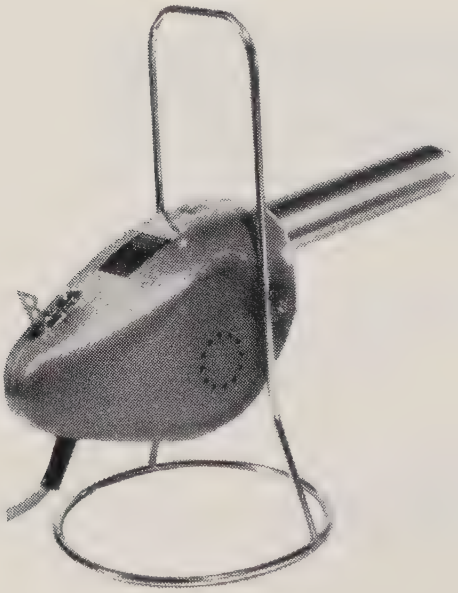

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Can be used from an earthed 5 amp. socket.

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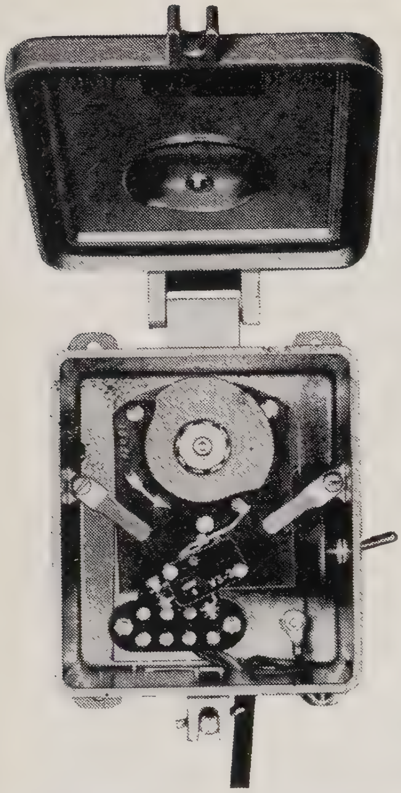

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A. R. Meetham, in collaboration with **D. W. Bottom** and **S. Cayton.**
Latest edition of the authoritative work in this field. Considers new smokeless fuels and appliances, smog, action taken against smoke and sulphur dioxide, and exhaust fumes from petrol and fuel oil. Implications of the Clean Air Act of 1956 and the role of legislation are examined. 316 pages. 70s ($10.00).

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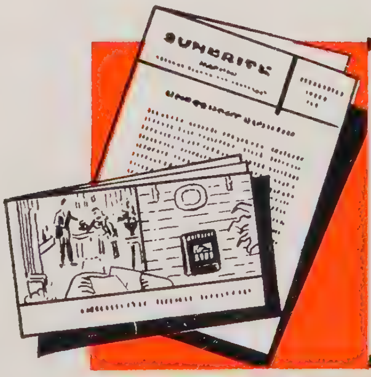

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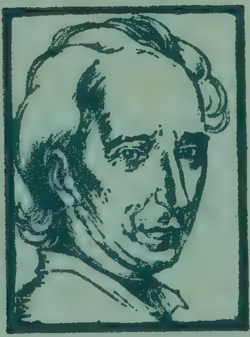
26-29 OCTOBER



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Proceedings of the 32nd Annual Conference Eastbourne

26th to 29th October, 1965

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SUMMARY OF EVENTS

THE 32nd Annual Conference of the Society was held for the first time in the Congress Theatre, Eastbourne, from October 26 to 29. 912 members and delegates attended and enjoyed the amenities of the modern conference hall so admirably suited for occasions of this kind.

On the morning of October 26 the delegates were greeted by sunshine and by the Civic Welcome given charmingly by Eastbourne's Lady Mayor, Councillor Mrs. K. J. Underhay, J.P.

Due to the pressure of Parliamentary work, Mr. R. J. Mellish, M.P., was unable to be present to open the conference, as had been arranged, and instead the opening address was delivered by the Parliamentary Secretary to the Ministry of Power, Mr. John Morris, M.P. After paying tribute to the work of the Society, Mr. Morris assured the conference of the Government's determination to reduce air pollution as far as it was economically and practically possible. Reviewing the present position both on the industrial and domestic front, he made some very forthright remarks about the local authorities in the black areas who were seriously lagging behind in their smoke control programmes. These remarks we now know were foreshadowing the letter which the Minister of Housing and Local Government sent to eighty-two local authorities in January 1966 asking them to review their attitude.

Sir Alan Wilson, F.R.S., then delivered his first presidential address, and, after a vote of thanks moved by Mr. Stanley E. Cohen, the platform party, led by the Mayor, proceeded to the Winter Garden to open the Clean Air Exhibition organized by the Society.

The afternoon session, chaired by the Chairman of the Society's Executive Council, Mr. J. Goodfellow, was an account of three "success stories" with smoke control from Sheffield, Scunthorpe and Manchester, which demonstrated what can be done given determination and goodwill on the part of all concerned. The problems of solid fuel distribution and supply were expertly presented by Messrs. E. Otty and W. H. Bourne.

Wednesday

On Wednesday morning Dr. Albert Parker presided over three varied subjects: a paper by Mr. A. J. Wicken on "A Recent Survey's Findings Concerning Air Pollution and Mortality from Lung Cancer and Bronchitis", "Odour Control by Catalytic Combustion" by Mr. E. Betz, and "Experience in Road Vehicle Pollution in Belgium" by Col. E. J. Coucke. The lively discussion which ensued reflected the delegates' interest in all these topics.

In the afternoon, parties went on visits to the Nuclear Power Station at Dungeness; the Reed Paper Mills, Aylesford, Kent; and the Alpha Cement Works, Lewes; while the delegates' ladies were able to visit the Pestalozzi International Children's Village and the Rudyard Kipling Exhibition and Museum.

Thursday

What each of the fuel industries hopes to offer to the domestic consumer in the future was the subject of four papers on Thursday morning with the theme "New Horizons in Domestic Heating" and under the chairmanship of Mr. A. C. Saword, Mr. H. R. Brewster of Shell-Mex and B.P. Ltd. and Dr. William Reid of the National Coal Board, made particular references to the part that oil and solid fuel respectively, could play in the future development of District Heating. Mr. R. N. Bruce of South Eastern Gas Board described the changes taking place in the gas industry and Mr. C. T. Melling, Electricity Council, spoke about the future for off-peak electricity.

The afternoon session, chaired by Mr. T. Henry Turner, was devoted to the consideration of some industrial problems. Mr. John Hodgson gave an expert's view on the selection of industrial dust collection and Mr. S. C. Beaumont, the Chief Smoke Inspector of Birmingham, outlined the progress and problems of assessing chimney heights, with particular reference to the *Memorandum on Chimney Heights* as it affected local authorities.

Friday

The last session of the conference on Friday morning with Mr. S. Cayton presiding, was entitled "Unresolved Problems in Air Pollution". The Chief Alkali Inspector, Mr. F. E. Ireland, gave a paper in which he emphasized the importance of solving industrial problems of air pollution prevention rather than relying on dispersion. Problems in the Local Government sphere were outlined by Mr. E. M. Birtwisle presenting a report of the Society's Parliamentary and Local Government Committee.

At the conclusion of this session the following resolution was proposed by the Warwickshire Clean Air Council: "That our best scientific knowledge should be employed to advise regardless of existing fuel interests on the most effective and economic form of home heating compatible with the attainment of clean air and to recommend a continuing revision of the National Fuel Policy in the light of such advice."

Then followed the moving of an omnibus vote of thanks to all concerned with the conference and the exhibition. The motion was approved with applause.

In order to publicize the Exhibition, a "Design a Clean Air Poster" competition was organized by the Society for Sussex and Kent schoolchildren. Visitors to the exhibition were able to take part in an adult competition to select the five best posters from the display in the Winter Gardens.

Social events included an informal "get-together" on the Monday evening, a golf tournament, conference luncheon and a highly successful Civic Variety Concert on Thursday evening in the Congress Theatre, by invitation of the Mayor and Corporation of Eastbourne.

The Opening Address

by

John Morris, M.P.

Parliamentary Secretary, Ministry of Power

MR. President, Madam Mayor, Ladies and Gentlemen. First I must apologise on behalf of my colleague, Mr. Bob Mellish, the Parliamentary Secretary to the Ministry of Housing and Local Government. I spoke to him last Friday and he wanted me earnestly to convey on his behalf his apologies for not being able to be with you this morning. One of those strange things is that sometimes Ministers are called to book in the House of Commons, and every few weeks your turn comes up for question time, and today happens to be the day that the Ministry of Housing are very high in the order of batting in the House of Commons, so that it is vital for Mr. Mellish to be there. He obviously would have been the best person on behalf of Her Majesty's Government to address this Conference because we all know the important part that the Ministry of Housing plays as far as clean air is concerned.

I share with him some responsibility because, as your President indicated, one is for it and the other is the cause of it. He and his Minister have the great task of assisting and guiding local authorities in the designation of smoke control areas, and our job at the Ministry of Power is to ensure that there are at all times adequate supplies of smokeless fuel available, so that they can get on with their job. If we do not do our part, if we do not assure the suppliers, then the battle is lost in the first stage. It is a pleasure for me to be here, as the first member of Her Majesty's present Government to speak to you, and to try on behalf of Mr. Mellish to put before you some of the points that he would have put, had he been here.

I would like on behalf of the Government to extend to you, as a Society, our deep appreciation of the enormous voluntary work that has been done by you over the years. I was reading before I came down, of the beginnings of this Society, the pioneering effort that has been made, your great task above all else of conditioning public opinion—and unless in a democratic country like ours we are able to condition and carry public opinion, there is not a great deal that you can achieve. I think it is an enormous tribute to the great work, the great life of this Society, that it has been able to condition and to educate public opinion, so that we have been able to achieve the minor successes that have been achieved hitherto; and it is my pleasure on behalf of the Government to extend to you our most sincere congratulations and thanks for the driving force over the years.

Secondly, Mr. President, I would like to make it clear—if it is necessary to make it clear—to everyone, to local authorities, to industry, to the general public, that the Government is determined to see that air pollution of all kinds is reduced to the fullest possible extent that is economically and practically possible. On this issue let there be no doubt that we want to stand up and be counted. We are definitely on the side of extending and improving the air of this country. I would like to go through the stages, looking first at the industrial side and the measure of achievement there, and then going on the domestic side, and try to evaluate how far have we got, and how far can we go in the immediate future. In this kind of field progress is slow, occasionally hardly perceptible. Some of us would like to go very much faster and it is important for us to be realists and try to face up the measure of achievement that we have attained.

One of the things I am trying to do in my very minor office in Government, so far as my advisers are concerned, so far as my colleagues are concerned, so far as my opponents are concerned and above all else so far as I myself am concerned, is to try and face the reality of each situation. On the industrial side, as we all know, there has been close co-operation between the Government as represented by the Alkali Inspectorate, and industry, and of course there are many problems still unsolved in this field. As regards the details, I do not wish to trespass on the field of the address of Mr. Ireland to you later this week. But I think that with this part of the battle we are fully entitled to blow our trumpets on all sides, for the great achievements that have been made by British industry in ensuring that we have better air. I think that this co-operation between the Inspectorate and industry is unique, and that it has resulted in standards in industry which are the highest in the world. We sometimes tend to denigrate British achievements, but in this field I am advised that they are the highest in the world and improving steadily year by year.

I doubt, Mr. President, whether the industry of any other country does so much of its own accord, and out of its own pocket, to reduce air pollution. Among our problems, there is that of grit and dust, and here local authorities and those responsible need guidance, need standards. On the advice of the Clean Air Council a working party was set up and as a result of its investigations one hopes there will be guidance, and satisfactory guidance, issued fairly shortly. Likewise so far as premises for which local authorities are responsible, there has been of course immense co-operation, and there has been a two-way traffic of the Inspectorate and local authorities, each one assisting and drawing from each other's experience and assets. I think it is obvious to all of us that since the Clean Air Act came into force, industrial smoke has been substantially reduced, and that at a time when there has been an increase in productivity in this country, an increase in growth and a resulting increase in demand in fuel consumption.

The Domestic Side

Let me turn now for the moment, Mr. President, to the domestic side and to examine once again, in the nine years that have gone by since the Clean Air Act came into force, the measure of our achievement. First, let us be frank: there is no hope of fulfilling the timetable of the Beaver Committee. Reporting as it did in 1954, it suggested that within ten to fifteen years every dwelling in the black areas would be able to burn smokeless fuel, and it came to that conclusion on certain policies and certain assumptions, but such have been the enormous changes in that time that some of those assumptions are no longer true. They thought first that gas coke would meet the demand for open fire smokeless fuels. There have of course been immense technological changes in the gas industry and it is obvious to all of us that production of gas coke over the years will go down. Then there was the assumption that the average cost of conversion would be about £10; and thirdly there was the assumption that every local authority in a black area and the public generally would gradually accept the need for a smoke control area.

These were the assumptions, and the first two certainly no longer hold good. There have been great changes in the gas industry, and the cost of conversion has trebled since the Act came into force. Adjustments have therefore had to be made to the Clean Air grant arrangements to ensure that use was made of all available smokeless fuels without concentrating on any one particular type, and so far as solid fuel supplies are concerned I am delighted to repeat what I said to the Clean Air Council in January, and my statement then was issued as a White Paper to local authorities and other interested parties. I repeat that so far as the supply of solid smokeless fuels is concerned things have got a lot better since the 1963 White Paper. The Coal Board and the private producers have between them stepped up their plans so that if the demand is there, 1½ million tons of open fire smokeless fuels will be made available over and above the amount estimated in 1963. I am sure you will all agree with me that this is worthwhile progress, and I understand that the Coal Board hopes to market its new fuels this winter, and very excellent fuels they are.

That is the situation so far as supplies are concerned. Supplies are adequate, although there may be some difficulties in some areas and some people may have to burn premium fuel whereas they might have preferred to burn cheaper fuels, and this has necessitated in some areas to change the grant arrangements. I am confident that the grant arrangements meet the new situation and that the problem of solid fuel supplies is being solved. So, therefore, on these facts, so far as my Minister's responsibility is concerned, with respect to the supply of smokeless fuels, there is nothing to stop local authorities in the black areas from going ahead with a regular programme on smoke control orders. We have done our job, and are doing our job, and the producers are doing their job, and again I am very glad to be able to say that all the major cities seem determined to complete their smoke control programmes as soon as they can. One has only to look at the progress in London, Manchester, Sheffield, to name only three. The progress there is clearly visible, especially on a misty day like this. What a situation it would have been in London this morning had there not been the progress of the last nine years. I might not have been here with you this morning! Some of the smaller black area authorities are already ahead of, or at any rate keeping pace with the leaders.

The Laggards

However, it is obvious and I think we should face it, and you as a Scieoty, if I may use the phrase, a Society of missionaries and of pioneers in this field, will be horrified to know—and know in fact, as well as I do—that some local authorities are seriously lagging behind, especially in the very black areas which we want to tackle above all else. I regret to say that about 27 per cent—this is a staggering figure—of all black area local authorities have either not begun to make smoke control orders or have up-to-date covered less than 1,000 premises by smoke control orders. There is an immense task in front of these people. Whatever their reasons may be, and some of them will probably be understandable even if they are not acceptable to us, I don't think and I am sure none of you will think, that this country can afford to let them lag behind any longer. We all suffer together when the air is polluted; we cannot isolate ourselves from the effects of foul air and we all benefit together from clean air. We know that we cannot yet get rid of or avoid all pollutants, but we can get rid of one of the major enemies, smoke, and it is the duty of every local authority in the black area to do so. I earnestly hope, and so does my colleague in the Ministry of Housing and Local Government, that the comparatively few non-starters will now take up the running and even though there is at present no statutory duty laid on local authorities to exercise their powers there is no doubt, in the interests of their own people and to meet amenities, they ought to exercise them.

So far I have dealt only with industrial emissions and smoke, and some of you will question what is the progress in the other fields, and what about sulphur dioxide? Here it is my privilege to congratulate the Society on the invaluable study of their Technical Committee. The Government agrees with their broad conclusions even though the problem of sulphur dioxide is at present insoluble in economic terms. We should do all that is economically possible to reduce total emissions and to reduce its concentration in the air that we breathe. Here perhaps it would be useful to clear any misunderstandings that there may be, and to say that the latest medical advice and research suggests that sulphur dioxide by itself, in the concentration usually found in our cities is not harmful to health, though it may have harmful effects in association with other pollutants. It is important to bear this in mind so that we can get our priorities right. Sulphur dioxide is a major and a most undesirable pollutant with obvious undesirable effects on buildings, and we must do our best to reduce it, though it alone does not appear to be the major health hazard as some would have us believe.

Motor Vehicles

Now if I may turn very briefly to the subject which the Mayor raised in the course of her Address; the question of motor vehicles. They, like the poor are always with us. We cannot avoid the motor vehicle. It is here in every street, in every town, and every community; it is the great indispensable of our age. Its exhaust is a matter which has caused great concern to all of us for years, and here too I would like to clear up some misconceptions. First, it has been alleged that the motor vehicle may be guilty for the lives lost through lung cancer. The Ministry of Health and the Medical Research Council tell us that although the exhaust products of petrol engines and maladjusted diesel engines do sometimes contribute small amount of carcinogenic hydrocarbons, the concentrations are minute compared with those found in coal smoke and that there is no evidence as yet to suggest that motor exhausts causes cancer. My friend Mr. Mellish has recently been studying this difficult problem of pollution from vehicle exhausts with his colleague, Mr. Stephen Swingler, the Parliamentary Secretary at the Ministry of Transport, and they have come to the conclusion, on the best possible advice available to them, that while diesel smoke is a major nuisance and possibly a possible traffic hazard it is not injurious to health. On the other hand, carbon monoxide, which is not an obvious nuisance, may affect drivers' efficiency in certain circumstances, as we all know.

What my colleague at the Ministry of Transport has done is to ask Sir Patrick Hennessy, the President of the Society of Motor Manufacturers and Traders, if they will concentrate their efforts on seeking ways of reducing to the minimum possible extent the emission of carbon monoxide from the petrol engine. I am pleased to say that he has just received an encouraging reply which emphasizes that the industry's research in this field is on an active and increasing scale and is being treated as you will all be pleased to know as a matter of urgency. But I think that it would be foolish to pretend that there is likely to be any single easy solution to the problem: the major line of attack must be on the source of the pollution, the engine itself. While it is necessary to concentrate on the urgent fields of research as I have outlined, we must not forget the importance of other policies in other fields which add up to the sum total of improving the general position. The building and constructing of by-passes and highways, the reduction of traffic in urban centres, sound town planning—all these help to move traffic more quickly, and at the end of the day all this must be beneficial to our general health. Then so far as the diesel engine is concerned, no doubt all of us have cursed the oily black smoke from a badly overloaded, badly maintained diesel truck which may have been travelling up a hill in front of us. We have said that something must be done about this and how terrible the emissions are, and what a nuisance it is creating. Of course, and in fairness to our engineers and manufacturers, and to the bulk of transport drivers and those whose duties it is to maintain these trucks, if they are properly maintained, properly driven and properly loaded, diesel vehicles do not emit smoke, but the Ministry of Transport are determined that operators should be made to realize that diesel smoke will not be tolerated, and the Ministry of Transport are therefore continuing and intensifying their policy of road checks and is arranging for all diesel engined heavy goods vehicles to be regularly checked for smoke in the special testing stations which are to be set up for goods vehicles. Fixing power and the rate ratio for goods vehicles is another thing planned. This will help because overworked diesel engines, which, as we all know from our sad experience, are particularly prone to smoke. I am sure that operators, those responsible for running fleets of diesel engined vehicles, or even one vehicle, will find that it pays them to treat their vehicles properly rather than to have them taken off the road in the middle of their journeys, loads and all. I think that this is an indication of the seriousness and the sense of urgency that the Ministry of Transport have about this problem. They are intent on tackling it and will take the measures that I have outlined.

I think all I have said is an indication that so far as the many individual problems of clean air are concerned, each of the Ministries concerned is doing what it can to tackle its own particular problems. The Ministry of Health are looking, as I have indicated, at each of the health aspects, the Ministry of Housing and Local Goverment are determined, in the very strong terms that I have set out, to ensure that those local authorities in the black areas which are lagging behind must soon take decisive steps, because the country cannot tolerate the existence of unclean air as it is now in those parts. So far as the Ministry of Transport are concerned this sense of urgency is apparent in the steps that they have already indicated; and we in the Ministry of Power are pleased to say that so far as the supply of smokeless fuels are concerned, they are available, and that the local authorities certainly cannot blame supplies for the necessary extensions which are needed in this field.

Public Opinion

In conclusion, let me say this, Mr. President, that at the end of the day clean air depends, as we all know, and as this Society particularly knows, on the strength and force of public opinion. I believe and this is in part a tribute, as I said earlier, to the great and pioneering work of this Society: I believe that the public generally is at last beginning to realize that clean air is as necessary and as vital to the good health of our citizens as clean water. We have spent enormous amounts of money, enormous amount of time and energy, in providing clean water for the people, and I am glad that there has been success, so far, since the passing of the Clean Air Act in also providing clean air for our people. It is obvious to all of us that air pollution is a social evil which can and must be overcome. Your Society has done more than any other body to bring the public to this realization. Again let me on behalf of the Government thank you. We all owe you a debt of gratitude for your untiring efforts going back for many many years in the cause of clean air. Thank you for allowing me to speak here this morning. I am delighted to be with you, and I am delighted to be with you for the rest of the morning.

Presidential Address

by

Sir Alan Wilson, F.R.S.

BEFORE commencing my address, I would like to say how much I appreciate the honour of serving as President of this Society, which has done and continues to do so much service to the community by bringing the facts of air pollution to the attention of the public. The improved standard of living which we all enjoy is due to the increasing industrialization of the country, and industrial processes are accompanied by noise and by dirt. These nuisances were once accepted as necessary evils, but this is no longer so, and there are very strong reasons why we should spend a proportion of our wealth on increasing our amenities. We cannot, of course, abolish noise and dirt altogether; to do so would be prohibitively costly. Fortunately much can be achieved in the reduction of air pollution by measures which show an economic gain by producing more heat with less expenditure of fuel, and we must use all our endeavours to increase the speed with which these measures are being adopted.

In Appendix III of the 1954 Report of the Committee on Air Pollution (the Beaver Report), it is stated that "a large volume of technical knowledge is already available about the nature and sources of air pollution, its effects and methods of prevention". But the Report goes on to list twelve important aspects of air pollution on which further research or development work is required. When the Clean Air Council was set up in 1956 under the Clean Air Act, one of its first tasks was to make a more detailed survey of these research and development problems, in conjunction with the Department of Scientific and Industrial Research and the Medical Research Council. As a result of these deliberations, a closer integration was achieved of the work being carried out in the field of air pollution. The primary responsibility for co-ordinating the existing work, and for seeing that new work was started, was assigned to the Fuel Research Station, Greenwich, the Director of which was my predecessor in office, Dr. Albert Parker. When the Fuel Research Station was closed down at the end of 1958, responsibility for the work on atmospheric pollution was transferred to the new Warren Spring Laboratory at Stevenage.

One of the tasks which was given a very high priority by the Research Committee of the Clean Air Council was the systematic recording of air pollution in a large number of localities throughout the country. It was felt that, since there are so many factors which might affect air pollution, it would be extremely difficult to determine the efficacy of the preventive measures which were about to be taken, unless detailed records were kept, which could be analysed. The Warren Spring Laboratory has recently published a comprehensive survey entitled "The Investigation of Atmospheric Pollution 1958—1963", and as I was one of the original members of the Research Committee, it is appropriate that I should review the findings of the Laboratory.

National Surveys of Pollution

When the Beaver Report was written, a certain amount of data regarding pollution was available, based partly on the trends in fuel consumption and partly on surveys carried out by 160 local authorities and other bodies. Some 1350 instru-

TABLE I

Consumption of fuels in G.B. from 1952 to 1962 in millions of tons

	1952	1957	1962
Coal—Domestic	37	36	33
—Industrial and railways	79	70	49
—Others	88	103.5	106
Coke	28	28.5	25
Oil	7	12.5	31

TABLE II

Smoke produced in G.B. from 1952 to 1962 in thousands of tons

	1952	1954	1956	1958	1960	1962
Domestic	1290	1340	1310	1270	1210	1160
Railway	280	260	240	210	180	120
Industrial	780	790	750	520	350	220
TOTAL	2350	2390	2300	2000	1740	1500

TABLE III

Emission of sulphur dioxide in G.B. from 1952 to 1962 in thousands of tons

	1952	1954	1956	1958	1960	1962
Coal	4270	4430	4440	4400	4270	4240
Coke	380	400	380	340	330	330
Oil	260	350	490	740	1230	1460
TOTAL	4910	5180	5310	5480	5830	6030

TABLE IV

Consumption of domestic coal, and emission of smoke and sulphur dioxide in the London region from 1952 to 1962 in thousands of tons

	1952	1954	1956	1958	1960	1962
Domestic coal	3600	3640	3230	2400	1880	1450
Smoke	141	150	135	100	75	57
Sulphur dioxide						
coal	223	258	251	227	225	224
coke	8	13	11	15	10	8
oil	3	16	31	44	128	186
TOTAL	234	287	293	286	363	418

ments were in use, but measurements were made mainly on a monthly basis and relatively few were made daily. Since pollution depends upon the balance between the amount of noxious matter produced in a locality and that dispersed harmlessly into the upper atmosphere, the trends in fuel consumption can only give a rough overall estimate of the extent of the pollution problem. Nevertheless, the changing pattern of fuel consumption provides some interesting background information. The figures given in Table I are divided into five categories, namely those relating to (1) coal for domestic heating, (2) coal for industrial and railway purposes, (3) coal for other uses, mainly electricity generation, coke ovens and gas works, (4) coke and (5) oil. This sub-division is relevant because, in modern conditions, smoke is emitted in insignificant amounts except when coal is burned inefficiently. To estimate the amount of smoke produced it is necessary to assume certain factors, based upon a limited number of tests, for the inefficient burning of coal in categories (1) and (2) above. These smoke factors are: 3.5 per cent for domestic coal, 2 per cent for railway engine coal, while for industrial smoke the factor has steadily dropped from 1.2 per cent in 1956 to 0.5 per cent in 1962. On these assumptions, the figures for the total smoke produced are shown in Table II, and it is clear that, although the total pollution has been considerably reduced, the diminution in domestic smoke has been disappointingly low.

The second main atmospheric pollutant to be considered is sulphur dioxide. In general, the crude oil which is imported into this country has a high sulphur content, and, though most oil products have low sulphur contents, the total amount of sulphur is not reduced by splitting the crude oil into fractions. It is merely concentrated in the heavier products, particularly oil used for steam raising in large industrial plants and in electricity generating stations. The increasing use of oil therefore means an increasing emission of sulphur dioxide, and this is borne out by the figures in Table III.

It is interesting to compare the figures given above, relating to the whole country, with the corresponding figures for the London region, which are given in Table IV. It will be seen that smoke has been reduced in London by about 60 per cent in 10 years, which is much better than the national average of only 35 per cent. On the other hand sulphur dioxide has increased in the London region by about 80 per cent as compared with slightly less than 25 per cent in the country as a whole.

While the figures for the emission of pollutants are interesting in themselves, measurements of the concentrations of smoke and sulphur dioxide at ground level are much more informative. Information of this type is, fortunately, more readily available now than when the Beaver Report was written, since there are at present some 3700 measuring instruments in use, operated by more than 600 bodies. Some results showing the difference between London and the rest of the country are shown in Fig. 1.

It is apparent from these diagrams that London is now much less smoky than other large towns, but more polluted with sulphur dioxide. The first of these deductions is a consequence of the fact that coal is ceasing to be the fuel of choice in London, whereas in other parts of the country the use of coal for domestic purposes has more or less remained constant. A further inference which can be made from the diagrams and from a study of the individual measurements on which they are based, is that the concentration of smoke at ground level depends very little on the size of the town. The major factor in removing smoke from its point of origin is dispersion upwards by atmospheric turbulence and not by horizontal drift near ground level due to the wind. Since the main cause of smoke is domestic coal, there is a strong correlation between the pollution at ground level and the amount

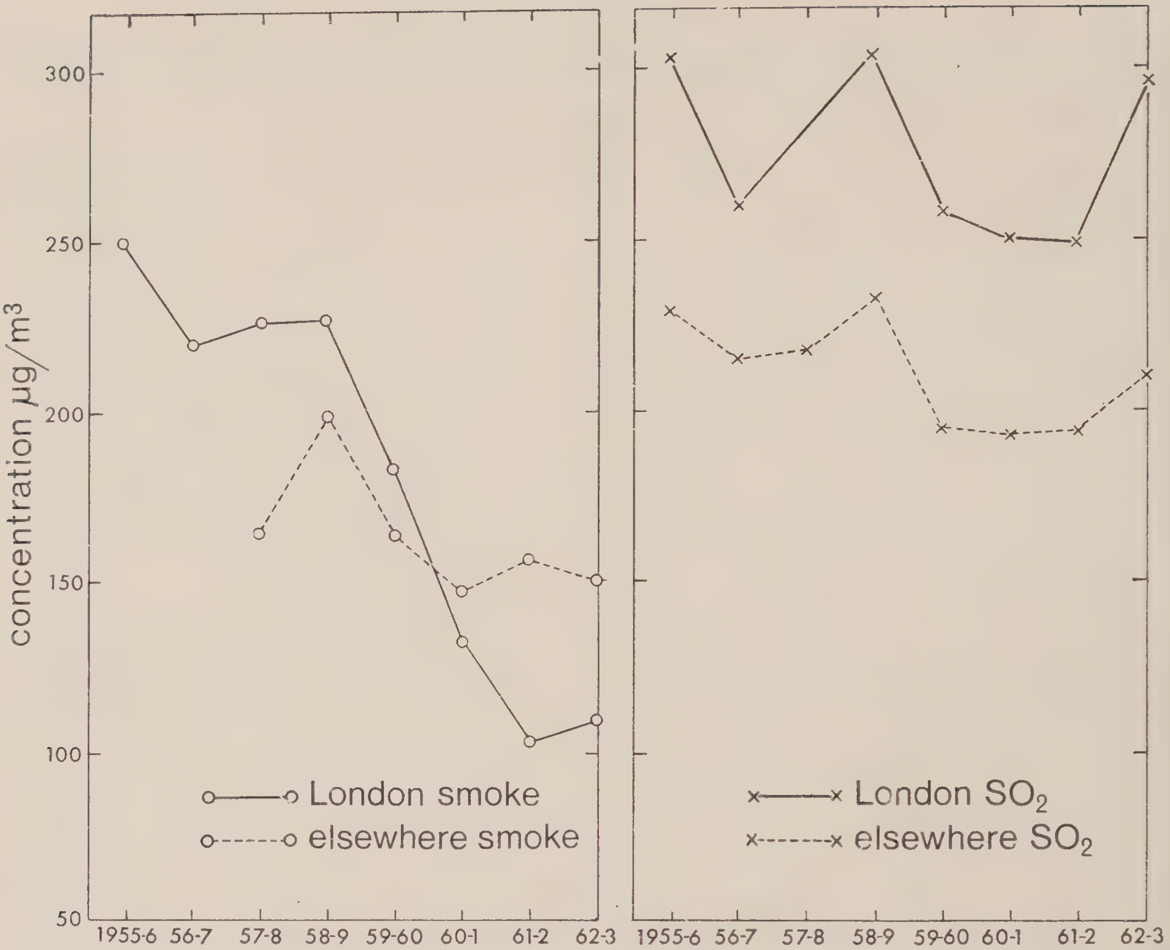

Fig. 1 Comparison of trends in London with those in the remainder of the country

of domestic coal burned in the area. This is shown in Fig. 2 which demonstrates the relation between the ground level concentration of smoke and the coal consumption per unit area in London and in Yorkshire. The greater pollution in many of the Yorkshire sites is clearly due to the larger coal consumption in those areas.

I would now like to analyse in somewhat more detail what has been happening in the last seven years, and to do this it is necessary to consider smoke and sulphur dioxide separately.

The effect of smoke control areas

The main factors affecting the reduction of smoke are the prohibition of the emission of dark smoke, and the introduction of smoke control areas by orders issued by local authorities. Dark smoke is no longer a problem, while between 1958 and 1963, "smokeless" areas have increased from 3,300 acres to about 280,000 acres. Although this is a substantial acreage, it leaves much of the so-called "black areas" practically untouched. In fact only about 20 per cent of all the premises in the black areas are in smokeless zones, and, as the findings which I discuss below show, this is too small a proportion to have a major effect.

It is impossible to state categorically how effective the introduction of smoke control areas has been because the weather has a considerable effect on pollution, and it is difficult to compare one year with another. Nevertheless, the following results have been obtained by special investigations.

The effect of introducing a small smoke control area in the middle of a large uncontrolled area was studied in Hackney, where there is a smokeless zone one mile long and half a mile

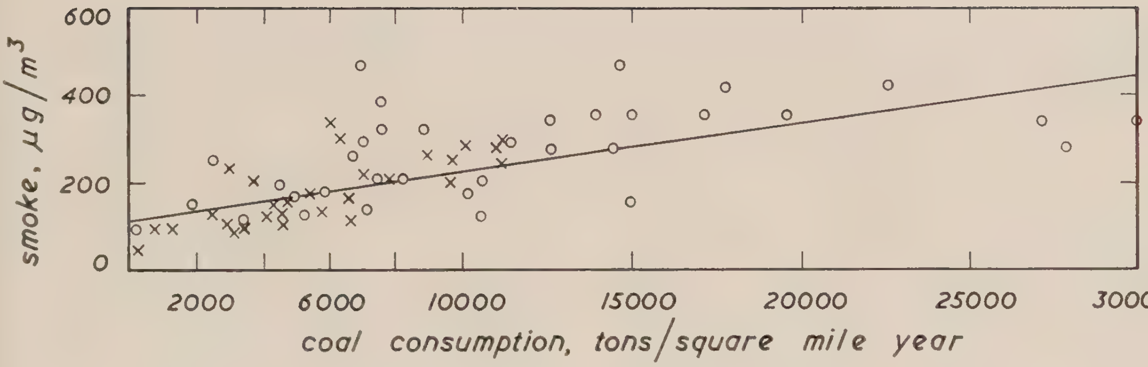

Fig. 2 Smoke and domestic coal consumption

wide. There is no heavy industry in the district, but there are a considerable number of factories and a wide variety of houses, shops and public buildings. It was found that the daily average pollution at the boundary of the smokeless zone varied roughly between the limits 150 μg/m³ and 200 μg/m³, and, during the winter of 1960-61, that the reduction in smoke at sites at least 400 yards from the windward edge of the zone averaged about 25 μg/m³. This is not a very large reduction, but in hourly measurements on one day during the following winter, a reduction of 70 μg/m³ was observed during the evening when domestic fuel consumption was at its peak.

Observations some years earlier in Hyde Park showed a much larger reduction in pollution. The smoke densities at the windward boundary of the Park varied from 150 μg/m³ to 500 μg/m³, while at the cleanest part of the Park the reduction in smoke was remarkably constant and averaged just over 100 μg/m³.

These results confirm the view that much of the pollution in an area comes from the smoke generated in the neighbouring areas, and that it is of comparatively little value to create small smokeless zones even if they happen to be those in which the greatest density of smoke is produced. To make a major impact on the problem it is necessary, as a minimum, to deal with areas of the order of 5 square miles as a single unit. Such an area would contain about 100,000 inhabitants, and the relevance of this to London and our large industrial areas is obvious.

A further extremely illuminating survey was carried out in about fifteen pairs of housing estates, which were as alike as possible except that one estate of each pair was subject to smoke control and the other was not. The average concentration of smoke over eighteen months in the smoke controlled areas was 100 μg/m³ as compared with 140 μg/m³ in the areas not subject to smoke control.* This is a most encouraging result, particularly since the smoke controlled areas were not unusually large, and it shows what can be done by changing over from coal to smokeless fuels or to oil.

The Sulphur dioxide problem

It will be seen from Fig. 1 that, whereas there has been a considerable reduction in pollution by smoke, pollution by sulphur dioxide has remained more or less constant. In addition, while London is now less smoky than the industrial north, its pollution by sulphur dioxide is greater. This seems a rather surprising result, but it must be read in conjunction with Tables III and IV which show how the total amount of sulphur dioxide has increased over the years. According to these figures London has done relatively better than the country as a whole, since the concentration of sulphur dioxide at ground level has remained constant while the total amount emitted has nearly doubled. In the rest of Great Britain the total amount of sulphur dioxide emitted has only increased by 20 per cent, and this has been accompanied by no change in the concentration at ground level.

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* This reduction could not be due to a greater reliance on gas and electricity in the smoke controlled areas, since this would show up in a reduction in sulphur dioxide pollution. The sulphur dioxide concentrations in both types of area were more or less the same, and this means that the reduction in smoke was due to the substitution of coal mainly by coke and, possibly to a small extent, by oil.

The facts quoted above, and the corresponding figures for smoke emitted and the concentration of smoke at ground level, show that much more sulphur dioxide is dispersed into the upper atmosphere than is smoke. This is because practically all smoke is produced near ground level, whereas a large amount of sulphur dioxide is emitted from tall chimneys.

The partial and gradual changeover from coal to smokeless fuels has had much less effect on the emission of sulphur dioxide than on that of smoke. The major immediate change brought about by the setting up of a smoke control area is the replacement of domestic coal by coke, which must be burned in a more efficient apparatus than the ordinary open grate. Since one ton of most low temperature coke contains only about 75 to 85 per cent of the sulphur in one ton of coal, and since 15 cwts. of coke produce as much heat as one ton of coal, replacement of coal by coke reduces the sulphur dioxide by about 40 per cent. This, however, has had little effect on the overall situation in the country since the number of smoke control areas is small and the consumption of coke represents only about 5 per cent of the fuel burned. The main factors in the last ten years have been the increasing use of oil products and electricity.

Some figures giving the amount of sulphur dioxide emitted by burning various fuels are shown in Table V. It will be seen that the use of oil for domestic central heating produces less sulphur dioxide than does coke burned in a closed stove, but that large oil-fired central heating plants and electricity generating stations, whether coal-fired or oil-fired, are relatively large producers of sulphur dioxide per unit of heat. The sulphur content of crude oil is high, and, as shown in Tables III and IV, the increase in sulphur dioxide is almost entirely due to the increased consumption of oil. A more detailed comparison between 1952 and 1962, classified by type of user, is given in Table VI, and from this breakdown of the figures it can be seen that the increased emission of sulphur dioxide has come mainly from electricity generating stations, the emissions from all the other types of user combined being more or less constant.

Since most electricity generating stations are either situated in open country or have high chimneys which ensure the dispersal of the furnace gases into the upper atmosphere in normal weather conditions, it is not surprising that sulphur dioxide concentrations at ground level in urban areas have remained more or less constant over the last ten years.

The increasing use of electricity is bound to be the most important factor in determining the consumption of fuel as far ahead as one can see, and it therefore seems probable that the concentration of sulphur dioxide in our cities will not increase, and may well decrease, particularly if nuclear power provides a substantial part of the nation's energy requirements. Unfortunately, the weather is not always normal, and temperature inversions in the atmosphere can create conditions in which both smoke and sulphur dioxide are trapped, and this leads to smog, the most notable recent examples of which occurred in 1952 and 1962.

The smog in London in 1952 was one of the main causes for the setting

TABLE V
Emissions of Sulphur Dioxide by the Burning of Coal and Oil

Application	*Fuel*	*Sulphur content per cent*	*Production of an amount of useful heat equal to that given by 1 ton of coal of 12,800 Btu/lb. burnt at 100 per cent efficiency*	
			SO_2 liberated, lb.	
			Solid Fuel	*Oil*
Domestic heating				
Open fire, old-fashioned type	coal	1·6	228	—
Open fire, improved type	coke	1·2—1·4	114—134	—
Closed stove	coke	1·2—1·4	72—83	—
Closed stove	anthracite	1·0	49	—
Boiler (including domestic central-heating boiler)	coke	1·2—1·4	76—90	—
Boiler (including domestic central-heating boiler)	anthracite	1·0	43	—
Boiler (including domestic central-heating boiler)	vapourizing oil	0·05—0·16	—	2.0—6·3
Flue-less heater	kerosine	0·03—0·04	—	0·9—1·3
Central heating				
Solid fuel boiler	coal	1·6	92	—
Solid fuel boiler	coke	1·2—1·4	69—81	—
Solid fuel boiler	anthracite	1·0	45	—
Oil-fired boiler, less than 500,000 Btu/h	oil	0·75—0·90	—	29—36
Oil-fired boiler, greater than 500,000 Btu/h	oil	1·4—2·8	—	54—108
Steam raising				
Industrial	coal	1·6	92	—
Industrial	coke	1·2—1·4	69—81	—
Industrial	oil	2·5—3·8	—	96—150
Electricity generation				
	coal	1·6	94	—
	oil	3·0—4·1	—	110—150

TABLE VI

Details of emission of sulphur dioxide in Great Britain for 1952 and 1962 in thousands of tons

	1952	1962
Coal		
Domestic	880	850
Electricity works	950	1720
Railways	380	180
Industrial	1760	1240
Coke Ovens	100	90
Gasworks	200	160
Coke		
Domestic	50	80
Industrial	330	250
Oil		
Gas oil	20	70
Derv.	20	20
Fuel oil		
Electricity works	small	430
Others	220	940
TOTAL	4910	6030

up of the Beaver Committee, and it led to the Clean Air Act. In the worst polluted parts of London the smoke concentration reached 8000 $\mu g/m^3$, while the sulphur dioxide concentration reached 3500 $\mu g/m^3$. In 1962 the highest concentration of smoke recorded (averaged over 24 hours) was 4550 $\mu g/m^3$ in Hackney, and the highest (averaged) concentration of sulphur dioxide, also in Hackney, was 4570 $\mu g/m^3$. These are some ten times the peak concentrations during a typical winter evening. While the complete disappearance of domestic coal would result in the elimination of the smoky constituent of smog, it would do little to alleviate the sulphur dioxide nuisance. The only cure would be the discovery of an economic process for the removal of sulphur dioxide from flue gases, and in spite of much devoted experimental work, no promising lines of advance have appeared.

Since there is no reasonable prospect of reducing the total emission of sulphur dioxide throughout the country to negligible proportions, there is only one solution to the problem of smog, namely town planning accompanied by the control of emissions by the regulation of fuel usage.

Ideally towns should be divided into residential and industrial areas, and the industrial belt should be on the down-wind side of the town with a gap of at least one mile between the line of industrial chimneys, which should be high ones, and the nearest houses. Heating in the residential belt should be by gas, electricity or solid and liquid fuels with low sulphur contents, while fuels containing high concentrations of sulphur should be restricted to the industrial belt. This is the ideal, and we must strive for it, and its achievement will depend upon the weight of public opinion and the actions of the planning authorities. Our existing large cities cannot, of course, be re-planned in this way, since it would be impossible to remove all industry to the periphery. But much can be done by insisting on the use of low-sulphur fuels whenever possible. If it proves to be impracticable for a sufficient number of existing users in our large conurbations to base their operations on low sulphur fuels, the only other remedy is to remove them to a properly situated industrial belt as and when the works need to be rebuilt.

Successes with Smoke Control

(I) MANCHESTER

by

J. Richards, M.A.P.H.I., A.M.Inst.F.[*]

ABSTRACT

There has been some form of smoke control in Manchester for over 120 years, and because powers to control the nuisance were sought early, the city has been called "The Home of Smoke Abatement".

Manchester was the first local authority in this country to obtain powers, under the Manchester Corporation Act, 1946, to establish "Smokeless Zones", and 14 such zones were established prior to the Clean Air Act.

The policy of the City Council is to make most of the city smokeless by 1970. The programme is being vigorously implemented; 41·5 per cent of the total area of the city, and 27 per cent of the total premises, are already subject to smoke control orders.

Smoke has been reduced by 25 to 44 per cent in existing smoke control areas, despite the proximity of other areas not yet under smoke control. Nevertheless, pollution levels are still dangerously high in some parts of the city during periods of fog.

A great deal of work remains to be done, and there is no complacency at the rate of progress.

1. Historical.

MANCHESTER is, and has been for a long time, the centre of a large industrial conurbation. Consequently it is not surprising that it has experienced most of the worst effects of the Industrial Revolution and still retains some of the scars of that period.

Air pollution was a serious problem in the city as long ago as 1848, when it had the doubtful distinction of being the first place where the dark melanic "carbonaria" form of the Peppered Moth was taken; indicating that the trees were already so dirty that the typical light coloured moth had become conspicuous against the blackened background and was being eliminated by birds.

In 1845 Engels drew attention to the squalid housing conditions in parts of the town. Even before that other reformers had drawn attention to the ill effects of dirty air, and the Manchester Police Act of 1844 included the provision that "Every person who shall, within the distance of one hundred yards from any dwellinghouse, burn coffins or coffin boards, or any rags, or any offensive substance so that the same shall be an annoyance to any inhabitant" should be liable to a fine of up to forty shillings. The same Act, in advance of national legislation, included a requirement that "Every furnace employed in the working of engines by steam, and every furnace employed in any mill, factory, dyehouse, iron foundry, glasshouse, distillery, brewery, bakehouse, gasworks, or other building used for the purposes of trade or manufacture, shall in all cases where the same shall be practicable be so constructed as to consume or burn the smoke arising from such furnace."

In 1883, the city's Medical Officer

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of Health, Dr. John Leigh, made a report to the City Corporation on Coal Smoke. He said that in 1866 he had reported that the excessive mortality in Manchester was largely due to its vitiated atmosphere. The citizens had a higher standard of living than agricultural workers, and a relatively high standard of sanitation, yet they were amongst the most unhealthy in the Kingdom. Smoke formed a dark canopy over the town, and caused a constant murkiness in the streets. On the finest day the vista was obscured by a column of haze that could be seen from several miles away.

In 1886, George E. Davies, late Government Inspector of Chemical Works, lecturing in Manchester on Smoke Abatement, stated that there would never be a coal fired domestic grate which could be smokeless under all conditions, and that the remedy for domestic smoke was to use smokeless fuel.

It is apparent that the problems and the remedies have been well understood for a long, long time; but it is only since the 1939–45 War, that smoke control has achieved much beyond a limited effort to reduce industrial smoke.

It is easy to be wise after the event, but the establishment of smokeless zones or smoke control areas seems so obvious a way of preventing air pollution, that it is difficult to understand why it was not adopted earlier.

2. Smokeless Zones.

In 1946, in response to representations made (in 1938) by the National Smoke Abatement Society, Manchester was the first local authority in this country to obtain powers, under the Manchester Corporation Act, 1946, to establish "Smokeless Zones". The Act also included provisions relating to the "prior approval" of new furnaces.

Due to post-war difficulties in the supply of fuels and equipment, implementation was delayed, and the first smokeless zone in the city came into operation on 1st May, 1952. It was 104 acres in area, contained about 1,100 separate premises of the commercial multi-storey type, and accommodated a large day-time population. There was whole-hearted co-operation from the owners and occupiers of premises, and during the autumn of 1953 the obvious success of the scheme gave rise to a public demand for the area to be extended. Three similar contiguous areas were added, and the central smokeless zone now covers 412 acres of the city centre. It was, and is, an excellent example of the improvement effected by smoke control.

Ten further smokeless zones were established under the local powers, before the Clean Air Act, 1956, came into operation. They were located in clearance areas about to be redeveloped and were a logical correlation of the clearance of unfit houses with a clean air policy. They were, however, rather small and too scattered to make any significant difference to local pollution.

3. Smoke Control Areas (Soft Coke).

In establishing smoke control areas, as in boxing, a good big 'un will always beat a good little 'un. When the Clean Air Act became law, the grant provisions enabled the altering of domestic grates to be tackled on a scale that was not possible before, and made the inclusion of large areas of housing a practicable proposition. The opportunity was welcomed by the City Council, and they decided to establish smoke control areas covering most of the city by 1969.

To obtain experience in the use of the new powers, before attempting larger areas, a pilot scheme was undertaken in an area of about 50 acres, which was being redeveloped after slum clearance. Approximately 200 dwellings of different ages, types and sizes, were to remain after the clearance, and it was thought that they would provide a good introduction to the problems likely to be encountered. They did.

For so small an area, the variation

in conditions was remarkable, and although most of the work was completed without any real difficulty, it soon became obvious that dealing with domestic grates was an administrative rather than a technical problem.

One case occurred early in the exercise, that has made nearly all the others since, seem simple. It involved the replacement of a large old Yorkshire range by a tiled surround and inset coke grate with gas ignition. When the old range was removed, the constructional hearth was found to be sub-standard, and there was a large wood bearer underneath. This necessitated a new constructional hearth, trimming the floor joists and propping in the cellar. The owner-occupier was a tough old gentleman, 85 years old. He considered the extra cost for the hearth excessive, and refused to pay the contractor. The jobbing contractor was in financial difficulties and required prompt payment. Before an agreement between the two could be arranged, the owner-occupier unfortunately died, and his solicitor's authority had to be obtained so that the appropriate grant could be paid to the contractor.

After that, the difficulties of communicating with a Pole who spoke little English, and a volatile and short-tempered Maltese, who occupied adjoining houses, paled into insignificance.

The general plan in establishing the smoke control areas, was to start at the southern city boundary, and work northwards, "with the wind", to obtain the maximum cumulative benefit.

The first major area, of 3390 acres (5·3 square miles), contained about 18,000 houses and 400 other premises. Three industrial estates were included, with a variety of fuel burning plant in the factories; and there were a number of market gardens on the semi-rural fringe, which introduced an interesting diversion into the subject of soil sterilization by heat.

16,000 of the dwellings were in municipal housing estates owned by the Corporation. They comprised about forty different types of houses, flats and maisonettes, but because of the relatively few different types of existing appliances which had been installed, the initial survey was restricted to a sample of 1 : 40. Subsequently, to obtain information about appliances installed by tenants, and to ascertain which alternative colour of firefront they would prefer, it proved necessary to supplement the sample by a postal survey.

There were over 6,000 back-to-back grates (with boilers) in the Corporation houses. Replacement by modern soft coke burning appliances with warm air ducted to the scullery, would have cost about £50 each, and experiments were carried out to establish whether conversion was practicable, and if after conversion the performance of the grates was satisfactory. The experiments were successful and conversions made by the manufacturer of the back-to-back grate were fitted. This enabled the back-to-back oven, with its background heating effect in the scullery, to be retained; and substantially reduced the cost.

The North Western Gas Board were concerned in the experiments, and later in the conversions, and although their interest was not of course entirely altruistic, they are to be congratulated on their enthusiastic and continuing support for the Clean Air policy.

Every privately owned dwelling was visited and surveyed, and this, in addition to providing accurate information about the existing appliances, was a good exercise in public relations. It was reassuring to find that the vast majority of residents were in agreement with the proposals, and that little opposition to the changes was likely to arise.

About this time the "North-Western Regional Council for Realism in Smoke Control" began to organize opposition to the proposed smoke control order by circulating criticism of the scheme, and by collecting signatures on "forms of objection" which they provided. Later, when the smoke control order was advertised, 420 of these objections (representing 2½ per cent of the householders), were sent to the Minister, and arrangements had to be made for the holding of a Public Inquiry. When the Inquiry was held not one objector appeared, not even a representative of the organizers of the opposition; and the Smoke Control Order was subsequently confirmed by the Minister.

No first hand knowledge of the origin or constitution of the "North-Western Regional Council for Realism in Smoke Control" could be obtained, but it was understood that a coal dealer in Liverpool had financed the cost of printing and circulating the forms, and the subsequent collation of completed forms and submission to the Ministry.

Other than this, there has been no organized opposition, and no other Public Inquiry has been necessary up to the present time (June 1965) in connection with subsequent smoke control orders.

The clearance of unfit houses, and the policy of making the cleared areas subject to smoke control orders, has continued. During the city's growth, several smaller townships were incorporated, so that the areas of worst housing are scattered. For clearance, these areas are dealt with on the broad principle of "worst first", and the subsequent smoke control areas form pieces of a gradually growing jigsaw north of the general line of advance of the larger smoke control areas.

Further larger areas of existing property have been surveyed, and brought under smoke control as quickly as the necessary work could be completed.

The second major area, of about 3·4 square miles, containing about 9,000 premises, was similar to the first, but the character of subsequent areas has varied, in that the majority of the dwellings have been privately owned. Despite the increased volume of work in dealing with a multiplicity of different appliances, owners and contractors, these areas have been completed without any serious difficulty.

Perhaps the worst feature has been the uneven flow of work. There is usually a comparatively quiet time about the middle of the period between the dates of confirmation and operation of an order and a last minute rush of estimates just before the order becomes operative. This inevitably leads to some conversions remaining to be completed after the order is operative. In such circumstances, the occupiers are required to comply with the order, and can do so by using premium fuels until the conversions are completed.

Notices

During the tidying-up process at the end of bringing an area into operation, it is necessary to serve a relatively small number of notices under the provisions of Section 12 (2) of the Clean Air Act. Most of these are in connection with work required at tenanted property and are due to chronic delay on the part of some agents. In a further small proportion of these cases it has been necessary to carry out work in default of compliance with the notice. A few less reputable agents see the default procedure as a method of using the local authority to carry out work which should be done by the agent, but this practice can be discouraged by the addition of the establishment charge of five per cent which the local authority is entitled to add by virtue of Section 292 of the Public Health Act 1936.

It is also necessary to serve a few notices to permit the payment of grant in cases of late applications by owner-occupiers or where vacant dwellings become occupied after the operative date.

Fortunately the need to resort to the service of notice is small, and in relation to the 57,962 premises covered by operative orders the number of notices required was 729.

Where notices are necessary it is convenient to specify the "reasonably necessary" work in terms of the provision of facilities to enable solid smokeless fuel (gas coke or hard coke) to be burned satisfactorily. To safeguard the occupier's right to freedom of choice between the alternative fuels, the phrase "or carry out suitable alternative work to avoid contraventions of Section 11 of the Clean Air Act, 1956" is added to the specification.

Costs

In estimating the probable cost of a smoke control area, it is necessary to include for the conversion or replacement of all the appliances "in regular use" in dwellings (other than "new dwellings"). Experience with "soft coke" areas has shown that, so far as privately owned dwellings are concerned, applications for the payment of grants have related to only about two-thirds of the potential total. There are a number of reasons why the actual costs for privately owned dwellings are less than the estimated costs, the main reason being the exercise of freedom of choice by the owner or occupier.

Some choose to use premium fuels, either in all their appliances or in those that are not used very often. This is convenient for a householder who wishes to avoid the expense and upset of changing existing grates, and is willing to incur higher fuel costs to do so. The householder is, however, advised to take the opportunity to alter his grates with the aid of grant.

Some appliances "in regular use" at the time of the survey are found to be "seldom used" at the time when the conversions are to be actually undertaken. This can be due to a genuine change in use, or to a change of mind on the part of the householder. "In regular use" is not defined. A grate used every Christmas Day is regularly—if infrequently—used. Where, however, there is any doubt, the evidence is usually limited to what the occupier says, and to the condition of the grate. Obviously one occupier with eighteen grates claimed to be "in regular use" would be regarded with some suspicion. In this connection it has been pleasant to find that the vast majority of people are commendably honest, and that attempts to improve private property at public expense have been few and far between.

A small proportion have the necessary work carried out, but do not bother to claim the grant to which they would be entitled; a few carry out work, without grant, before the order is made; and some prefer to use their own portable electric fires.

When a smoke control order is in operation, there still remains the duty of ensuring that contraventions are observed and that appropriate action is taken to avoid recurrence; also that any difficulties in obtaining suitable fuels are overcome, and that the appropriate remedy is applied in odd cases where the performance of a new appliance is not satisfactory.

Smoke inspectors do not have the time, or the inclination, to engage in street by street patrolling of smoke control areas, which, in any event, would be difficult, as there are already nearly 15 square miles of the city subject to operative orders. There are, however, many "volunteer assistants" who, having made their own homes smokeless, do not like to see any smoke made by others and report any such emissions to the department. These reports, together with inspectors' observations, enable an effective control to be maintained.

When smoke is observed the circumstances are investigated, and if the emissions constitute an offence the offenders are reported to the Health Committee. It has been the Committee's practice to caution first offenders, and so far these cautions, together with any necessary advice, have produced the desired result; so much so, that it has not been necessary to resort to legal proceedings for any offence in a smokeless zone or smoke control area. Offenders are left in no doubt that if informal means prove ineffective, formal action will be taken.

Sales of Coal

Sales of bituminous coal in smoke control areas, although accounting for only a minute proportion of the fuel burned there, are a temptation to the small minority who are willing to take a chance. Such sales are made from time to time by itinerant vendors who are not bona-fide fuel merchants, and who are an embarrassment both to the trade and the local authority. Bona-fide merchants are as interested as the local authority to ensure that such sales do not occur as, if unchecked, they could affect sales of smokeless fuels, and the Coal Merchants' Federation has an arrangement where by its members do not sell coal in smoke control areas.

The sale of coal in a smoke control area not being a contravention of the Clean Air Act, no formal proceedings under the Act are available against the supplier of the fuel. Nevertheless, in tracing vendors the Sale of Coal Byelaws, dealing with weights and measures, contained the useful requirement that the vendor's name and address should be exhibited on his vehicle. This obligation, however, is not re-enacted in the Weights and Measures Act, 1963, which superseded the Byelaws on 31st July, 1965. The Approved Coal Merchants Scheme provides a measure of protection against these sales, but the type of itinerant vendor who sells in smoke control areas is not concerned with codes of practice, or whether his customer is fined for emitting smoke. These sales are a standing invitation to householders to contravene a smoke control order, and cause trouble for the householder, the local authority, and proper fuel merchants. Consequently, in my opinion, the sale of bituminous coal in a smoke control area, other than for use in an exempted fireplace, should be made an offence.

A small amount of low volatile steam coal, as an authorized fuel, is used in domestic grates in smoke control areas. This fuel is very friable, and due to breakages in transit from South Wales much of it is undersize when it reaches the grate; because of this, and of its caking properties, its performance is sometimes unsatisfactory. It does, however, provide a last line of retreat for those who do not like to use other smokeless fuels.

There are still a few people who claim their health is adversely affected by any fuel other than bituminous coal, and who complain of fumes from solid smokeless fuels, dryness from the use of gas or electricity, and odour from the use of oil. As the best judges of how a particular fuel affects them, they sometimes remain unconvinced that there is nothing in coke that is not also in coal, and that if the chimney is open and working properly no fumes enter the room.

In a few instances, however, complaints of fumes in a room are found to be justified. These are invariably due to conditions causing the flue to work improperly, and the cause is usually easy to diagnose and remedy.

There are inevitably a number of people in smoke control areas who cannot afford the expense of converting their grates, and who apply for a discretionary grant in addition to the mandatory seven-tenths. When an applicant is receiving National Assistance, or would be entitled to do so if he chose to apply for it, the grant is increased to 100 per cent of the reasonably necessary cost of the work required. There have been 226 requests for additional discretionary grants and in 165 instances full grant has been paid.

In all cases where an owner or occupier prefers it, arrangements are made for the appropriate grant to be paid direct to the contractor, and there are standing arrangements with the Gas and Electricity Boards for the assignment of grant.

The aim is to ensure that areas are brought into effective operation with the minimum of inconvenience to the residents, and considerable efforts are made to provide a reasonable and kindly service, particularly to elderly people. Talks to interested groups in the areas by public health inspectors and visits to the areas by the Mobile Exhibition of the Solid Smokeless Fuels Federation have helped the work to progress in an atmosphere of willing co-operation.

Householders soon become used to using smokeless fuels, and once an order is in operation the main bone of contention is the price of fuel.

For the same comfort standard, smokeless fuels in the new appliances are cheaper to use than the old inefficient coal-burning open fire, but most users of solid smokeless fuels, on an open fire, choose to use a hundredweight of smokeless fuel where formerly they used a hundredweight of coal. Consequently they have a higher comfort standard, at some extra cost. There have recently been authoritative announcements about the availability of smokeless fuels; similar assurances that fuel prices are fair in relation to the costs of production and distribution would do much to remove the suspicion that fuel prices are unnecessarily high.

4. Smoke Control Areas (Hard Coke).

In December 1963 the publication of the Minister of Power's review of the availability of different smokeless fuels, "Command 2231. Domestic Fuel Supplies and the Clean Air Policy"; and the subsequent circular, No. 69/63 from the Minister of Housing and Local Government, produced some major changes in grant arrangements.

These changes came whilst we, in Manchester, were part way through the conversions in an area containing 10,000 dwellings, for which supplies of gas coke were assured. Grant for hard coke appliances, however, became available immediately and a considerable number of owners and occupiers did choose to use the alternative fuels. The conversions in the area became complicated as a result of the changes, and after the area was completed a sample of payments in relation to 1,500 dwellings was extracted in an attempt to assess how freedom of choice had been exercised. The details of that sample appear in Table 1 and whilst they are invalid for a genuine "hard coke" area they indicate that a considerable trend to gas had already occurred.

The owner's or occupier's freedom of choice within the wide range of alternatives available, presents some difficulties in estimating the probable cost of an area. Heating is like eating, every man is his own expert and what he chooses depends upon what he wants, what he likes, and how much he is prepared to pay. The Minister of Power's review commented that a 30 per cent displacement of solid fuels by non-solid fuels seemed likely At present it appears that the proportion displaced will be higher, but the position is further complicated by the planned increases in the availability of the premium fuels Homefire, Roomheat, Coalite, and Rexco. The actual extent to which householders may prefer openable stoves to underfloor draught grates, or the alternatives of gas or electricity remains doubtful. As the unit costs of the alternative installations vary widely some arbitrary forecast of the proportions has to be made by a local authority, and in estimating the costs for recent "hard coke" areas it has been assumed that 60 per cent of occupiers will choose hard coke, equally divided between stoves and underfloor draught grates, that 30 per cent will choose gas, and 10 per cent, electricity. In estimating the additional smokeless fuel requirements it is assumed that each dwelling uses 3 tons of coal per year, that hard coke replaces coal ton for ton, and that 315 therms of gas or 5,650 KWH off-peak plus 1,300 KWH on-peak electricity is equivalent to 3 tons of coal.

Since the Minister's change of policy, although a few small housing redevelopment areas have been dealt with under the new arrangements, no major smoke control area in the city has been confirmed. Two large orders are, however, with the Minister awaiting confirmation and further substantial areas are in the pipeline.

TABLE 1

Fallowfield and West Didsbury Smoke Control Order, 1963.

Analysis: Appliances in 1,500 Dwellings

Existing Appliances	*No.*	*Coke grates*	*Con-version sets*	*Under-draught grates*	*Open-able stoves*	*Closed stoves*	*Gas Fires*	*Elec-tric Fires*	*Electric storage Heaters*	*New Tile Sur-round*	*Ignition*	
											Gas	*Elec.*
Tiled Surround Open Grates	1,657	867	—	151	102	—	400	122	15	97	291	302
Tiled Surround Coke Grates	47	1	1	6	11	—	20	7	1	5	13	7
Combination Grates	105	55	9	6	28	—	4	2	1	74	26	16
Mantel Register Grates . .	445	275	—	10	9	—	100	48	3	274	107	39
Yorkshire Ranges	147	130	1	3	7	1	2	3	—	130	59	13
Underfloor Draught Grates . .	24	1	21	—	—	—	2	1	—	—	4	6
Special Ranges	7	1	3	—	2	—	1	—	—	2	—	1
"Devon" Grates	6	1	—	1	—	—	3	1	—	1	2	—
Back-to-Back Grates . .	1	—	—	1	—	—	—	—	—	—	—	1
Total No. of Appliances . .	2,439	1,330	35	178	159	1	532	184	20	583	502	385
Percentage	100	54¾	1½	7¼	6½	—	21¾	7½	¾			

Central Heating

	Solid Fuel	*Gas*	*Electricity*	*Oil*
Fired by . .	8	5	2	3

Although the change in policy has temporarily disrupted the progress that had been planned, and will probably increase the cost of an area by 2½ to 5 times what it was under the previous arrangements, it does have compensating advantages. It is generally accepted that, judged by space standards, the British home is one of the best in the world, but judged by heating standards it is one of the worst. Our heating standards traditionally have been low, and the comfortable area in most houses has been restricted to a semi-circle in front of an open fire in the living room, where one could roast in front and freeze behind.

More and more people want, and can afford, adequate heating in their homes. This is due partly to changing social circumstances and partly to the lessons of the awful winter in 1962–63. The appliances towards which grant is now available are much more efficient and permit higher heating standards, better utilization of fuel and correspondingly reduced air pollution. Underfloor draught fires and openable stoves take longer to fix than the improved open fire, and to overcome this disadvantage by using more of the available contractors, areas are now being established in the north of the city as well as the south. Furthermore the City Council has reiterated its determination to implement the smoke control programme at the maximum speed, with 1970 as the target date for completion of most of the city (excluding some unfit dwellings).

At the end of 1964, approximately 41·5 per cent of the total area of the city, and 27 per cent of the total premises, were subject to smoke control orders. The details are shown in Table 2.

The pricing of unit costs of conversion is not easy. Pricing is a series of variations on a theme, and there is room for argument about whether such pricing is an art or a science. An examination of unit costs is outside the scope of this paper but certainly a price should be realistic and fair. The Ministry Circular No. 51/65 on the subject should simplify this task and remove some of the anomalies that have occurred in neighbouring local authorities.

5. Is the Object Being Achieved?

The implementation of smoke control has become very complicated, albeit unavoidably; and the acid test is not whether the "system" works perfectly, but whether the object of abating the pollution of the air is being achieved.

The answer is an emphatic "Yes", and whilst the maximum benefit has to await the completion of the programme the trend of improvement is already shown by reductions of between 25 and 44 per cent in the measured amounts of smoke in existing smoke control areas despite the proximity of other parts not yet dealt with. There is, however, no cause for complacency at the rate of progress. Pollution levels can still be lethal in parts of the city during prolonged fog, which, although now uncommon, did occur in December, 1962. Table 3 shows the levels then experienced, and compares different areas, including smoke control areas. The trend in average levels of smoke and sulphur dioxide in typical areas is shown in Figs. 1 and 2.

It is hard for many people to appreciate that the most serious part of the smoke evil is due to the deadly, grey, tarry smoke that comes from domestic chimneys but the improvements in smoke control areas are convincing proof that clean air begins at home.

6. Pollution from Industry.

Manchester's industrial and commercial interests are very conscious that efficiency goes with smokelessness and that the image of a dismal, dark and dirty city is bad for business. Consequently the degree of co-operation afforded to smoke control is outstanding. This is not to say that it is all plain sailing, but most of the

TABLE 2

Manchester		*No. of dwellings in smoke control programme*
No. of dwellings in the City at 31.12.64		201,600
Of these dwellings:		
1. Unfit and intended to be demolished	54,700	
2. Subject to smoke control orders	50,000	
3. To be included in smoke control orders in 1965/1969..	85,000	
4. Leaving to be dealt with in 1970	11,900	
	201,600	

Item	*Areas*	*Premises*	*Dwellings*	*Acres*
1	14 Smokeless Zones made under Manchester Corporation Acts	4,764	2,623	522·64
2	9 Smoke Control Orders (Nos. 1 to 9) (Soft Coke)	49,489	47,169	8,884·36
		54,253	49,792	9,407
	In addition Redevelopment Areas include new dwellings. Some not yet built	3,709	3,709	
	Totals in areas subject to operative Orders at 31.12.64	57,962	53,510	9,407
3	8 Smoke Control Orders (Nos. 10 to 17) (Hard Coke)	14,169	13,304	2,876
	In addition Redevelopment Areas include new dwellings not yet built	2,729	2,729	
	These 8 Orders are made but not yet operative at 31.12.64	16,898	16,033	2,876
4	TOTALS excluding all new dwellings ..	54,253	49,792	9,407
		14,169	13,304	2,876
		68,422	63,096	12,283
	TOTALS including all new dwellings ..	74,860	69,534	12,283
5	Smoke Control Orders in preparation:			
	(*a*) BURNAGE	5,985	5,707	610
	(*b*) BLACKLEY (Survey almost completed	Approximate estimate: 25,000	23,000	3,000
	(c) WHALLEY RANGE (Survey completed)			
	(*d*) CHARLESTOWN (Survey in progress)			
	(*e*) MOSTON			

TABLE 3

Smoke and sulphur dioxide measurements on 4th, 5th, 6th 7th, 8th December, 1962, expressed in microgrammes per cubic metre.

	Miles Platting			Brownley Green (Smoke Control Area)			Clayton			Wythenshawe Centre (Smoke Control Area)			Crumpsall			Withington			Rusholme			Central ("Smokeless" Zone)		
December 1962	Smoke	SO_2	Ratio	Smoke	SO_2	Ratio	Smoke	SO_2	Ratio	Smoke	SO_2	Ratio	Smoke	SO_2	Ratio	Smoke	SO_2	Ratio	Smoke	SO_2	Ratio	Smoke	SO_2	Ratio
3rd/4th	688	595	1·16	232	339	0·68	804	751	1·07	236	238	0·99	820	925	0·89	508	516	0·99	632	1144	0·55	524	717	0·73
4th/5th	3643	1819	2·00	1292	1146	1·13	2181	2452	0·88	1048	934	1·12	2924	3246	0·90	2267	2472	0·92	3481	3073	1·13	2070	3238	0·64
5th/6th	3147	1931	1·63	776	807	0·96	2249	1850	1·21	484	551	0·88	3163	2152	1·47	2285	1499	1·53	2164	1910	1·13	2027	2113	0·96
6th/7th	2296	1028	2·23	844	772	1·09	1772	1535	1·16	688	547	1·25	3309	2386	1·39	2148	1399	1·53	2116	1301	1·63	1545	1788	0·86
7th/8th	316	158	2·00	64	205	0·31	376	445	0·85	60	101	0·59	316	326	0·97	144	212	0·68	224	194	1·15	280	400	0·70

In general, there was moderate fog at noon on the 4th December which became dense at 5-0 p.m., increasing to very dense later in the evening but reducing later and during the morning of the 5th December until almost clear by 11-0 a.m. There was some recurrence subsequently in different districts but the worst effects of "smog" were not experienced, the absence of prolonged, persistent fog avoiding a progressive build-up of pollution throughout the City.

The pollution recorded during a peak period 4/5th December at Rusholme represented approximately 4½ times the daily average for that site in December, 1961 and that in the central area was approximately 3 times the December, 1961 average.

The possible mortality significance of the peak concentrations is evident from the critical levels expressed by A. E. Martin, M.D., D.P.H., of the Ministry of Health in "Mortality and Morbidity Statistics and Air Pollution" as marking immediate excess mortality when above 2,000 microgrammes of smoke per cubic metre and 1144 microgrammes of SO_2 per cubic metre.

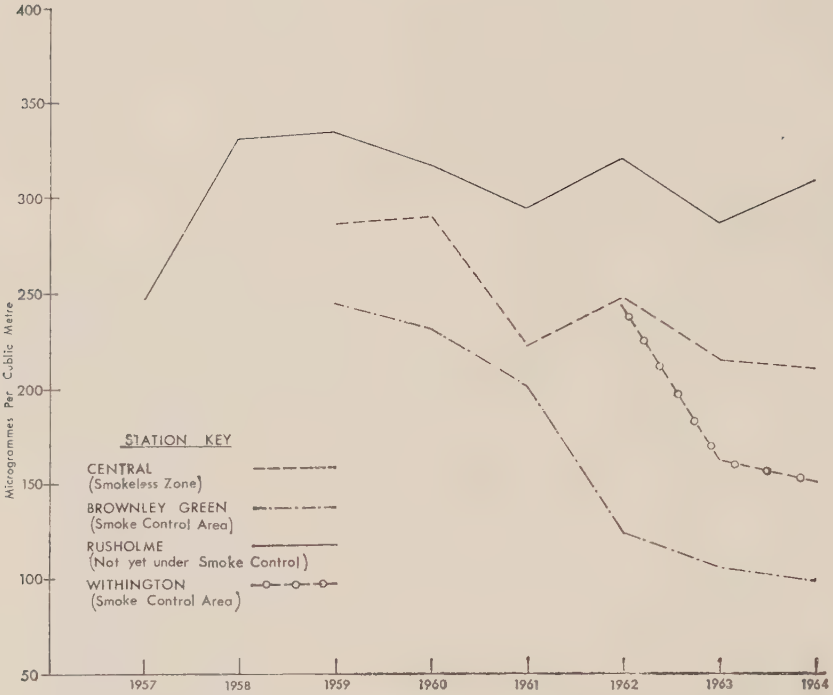

Fig. 1—*Smoke Concentrations—average daily figures*

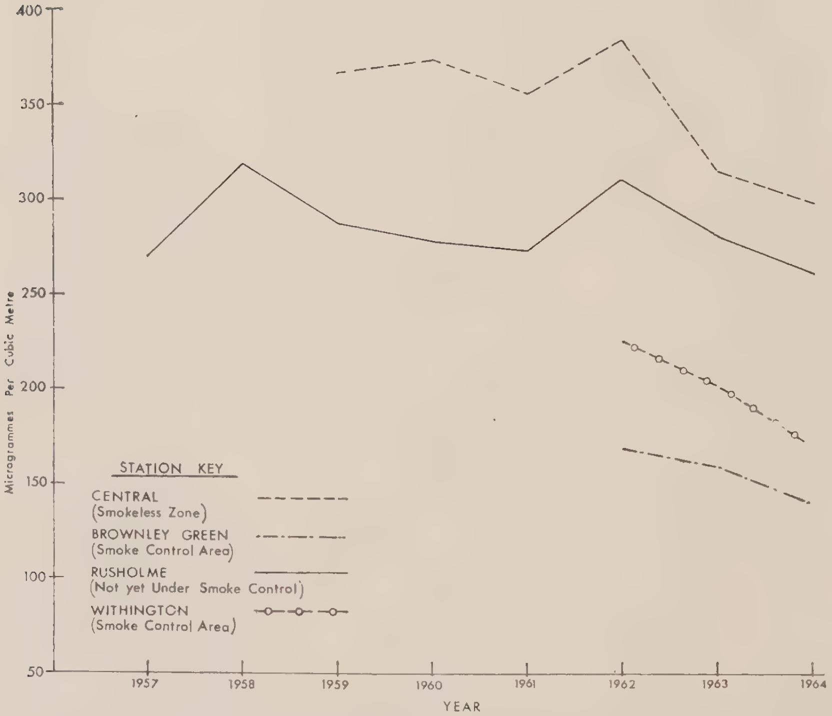

Fig. 2—*So*$_2$ *Concentrations—average daily figures*

work of the public health (smoke) inspectors is done informally by advice and persuasion, and it is only necessary to resort to formal action in about 20 cases each year when informal action has been unproductive.

Notifications and technical details received in the department in connection with "Prior Approval" of new furnaces and control of chimney heights have been progressively increasing, from 169 in 1961 to 355 in

1964. Some of the recent increase arose from new byelaws relating to the installation of oil-burning equipment which became operative in March, 1963; the rest reflects an increasing awareness of the Clean Air Act requirements.

In addition to the control of smoke, the policy of the City Council is also directed towards securing a reduction in emissions of oxides of sulphur to the atmosphere. Where oil fuel is used in Corporation buildings its use is restricted to grades with a sulphur content not exceeding one per cent, and when oil-firing is proposed in privately owned plant, the developers are urged to follow this example. Apart from some larger plants where high costs may preclude the use of such fuel, a fair measure of co-operation is secured.

From time to time trouble is experienced due to smoke from the burning of waste materials on open land. The nuisance order provisions of Section 16 of the Clean Air Act are slow and weak, and amendment to make such emissions an offence, whether or not they are likely to recur, would be an improvement.

Complaints about emissions of grit and dust are dealt with as they arise, but, because of the absence of a quantitative standard and difficulties associated with measurement, no systematic attack on this source of pollution has been attempted.

It should not be necessary to resort to measurement in all cases of grit emissions to determine whether they should be deemed to be offences under the provisions of Section 5 of the Clean Air Act, as gross offences can be adequately demonstrated by the traditional use of the greased glass plate. Nevertheless, in other cases, or for a systematic reduction of grit and dust, a standard of permitted emission is necessary.

The standard of 0·3 grains/cubic foot (N.T.P.), with not more than 0·03 grains/cubic foot of particles larger than 76 microns has been used, tentatively, in one or two instances where measurements were practicable, but a higher standard is desirable. Limitation of emissions to 0·2 grains/cubic foot (N.T.P.) with 12 per cent CO_2; or not more than one half per cent of the fuel used, seems to be the right order of magnitude. It is anticipated that a low or medium efficiency collector would be suitable to enable most stoker-fired shell boilers to satisfy a proposed standard; but it must be recognized that nuisance under Section 16 of the Clean Air Act could still occur, even if the plant satisfied the standard, if there were premises or processes nearby which were particularly susceptible to grit and dust.

The findings of the Working Party which is enquiring into this subject are awaited with interest.

7. Conclusion.

Even a dirty person objects to eating dirt, but most of us have to breathe dirty air whether we like it or not. Industry is responsible for some of the dirt, but most of it comes from the use of coal in ordinary open fires in houses.

Some pollution is inseparable from life in towns, but vigorous and intelligent use of the powers already available under the Clean Air Act can reduce it to acceptable levels. Some places, like Manchester, are showing the way, and there is no excuse for those "black area" local authorities that still ignore smoke abatement work.

The cost of air pollution, both in health and wealth, is enormous. It is true that the establishment of smoke control areas is complicated and costly but the benefits derived are well worth the trouble and expense. In terms of health alone, the abolition of smoke would do as much for public health in this country as any other single action.

The great majority of people are in favour of smoke control, particularly where the advantages of clean air have been demonstrated. The problem, now, is not to convince the public of the need, but to speed up the implementation of the remedies.

(2) SHEFFIELD

by

*J. W. Batey, D.P.A., M.I.Mar.E., F.R.S.H.**

ABSTRACT

The paper reviews the history of smoke abatement in Sheffield and describes the programme for smoke control areas. The method of using ward boundaries for smoke control areas is recommended. Tables are given showing the improvement in atmospheric conditions since 1956, in respect of both smoke and sulphur dioxide.

SMOKE and atmospheric pollution have been a health hazard ever since men lived in communities. It is no new thing. Coal has been burned (in the most wasteful manner) for centuries, and because of inertia and ignorance the resultant pall of smoke and grime has always been accepted in the past as a necessary concomitant of industry.

Sheffield in particular has been noted in the past for the number of its chimneys pouring out volumes of smoke night and day. Sheffield and smoke is an accepted synonym, as much as Blackpool and its Tower.

Any city which takes in rough minerals of the earth and produces steel must use an enormous amount of fuel, and the crude techniques of the past could not produce steel without also producing smoke and grime. Nor could homes be kept warm in any other way than by the burning of coal on open fires. The dense "houses per acre figures" of the past guaranteed an output of smoke which few of us could conceive today.

Sheffield City Council have been battling with the problem for over 130 years. In 1829, a circular was sent to all proprietors of steam engines expressing the determination of the Commissioners of the City to prosecute offenders. The six chimneys which were the greatest smoke producers were noted and the firm to be prosecuted was decided by ballot. But such methods will not do today and although the Council never gave up the struggle, they never had any real power until the passing of the Clean Air Act in 1956. This piece of legislation, which Sheffield had a hand in making, was essential before any major progress could be made to control pollution.

Sheffield City Council immediately took advantage of the powers thus given to local authorities by the passing of this Act, to curb the emission of smoke from domestic premises. The first Smoke Control Area became effective in 1959 and the following table shows the subsequent progress made in this City.

TABLE I

Area No.	*Effective date*	*Number of houses*
1	1.12.59	1,472
2	1.12.61	2,276
3	*1.12.65*	*6,057*
4	*In abeyance, road development*	
5	1.10.61	3,823
6	1.11.60	2,363
7	1. 7.62	7,987
8	1.11.62	5,836
9	1.12.62	7,044
10	1.12.63	7,765
11	*1.12.65*	*5,981*
12	1.12.64	7,333
13	*Under survey*	
14	*1. 9.65*	*4,861*
15	1.12.64	7,011
16	*At Ministry, awaiting confirmation*	

After many attempts to draw boundary lines for the first Smoke Control Area, a compromise boundary line which went a long way towards satisfying the various departments of the Corporation (whose co-operation is essential to the success of our Smoke Control programme) and other interested parties, was arrived at.

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* Chief Smoke Inspector, Sheffield and District Clean Air Committee.

It was always realized that the boundaries of the first Area presented various difficulties and with further experience it was decided that ward boundaries would be the most suitable method of defining future Smoke Control Areas.

This principle has been adhered to with manifold advantages which only become apparent as the work proceeds. The most immediate advantage to be gained from using ward boundaries is that all the domestic properties are listed on the Electoral Rolls. Maps showing the boundaries are also available and very little work is thus required to prepare estimates of cost.

Some cities appear to prepare a large number of very small smoke control areas. It is considered that this method must be time-consuming and must involve a large amount of office work for a very small return; whereas the system of using ward boundaries gives certainty to the overall plan and ensures a minimum amount of paper work and achieves noticeable and worthwhile results. (Table II).

The effect of this effort is probably best illustrated by examining the reading of the air pollution gauges as shown in Table III.

Not only has smoke dropped to an all time low (it has been approximately halved), but a convincing answer to the parrot cry of "what are you doing about sulphur?" is contained in the same gauge readings over the same period. (Table IV).

A huge programme is being under-

Table II

Total City Acreage	*Acreage under Smoke Control*	*Total number of houses*	*Number under Smoke Control*
39,598	24,136	168,000 (approx.)	70,000 (approx.)

TABLE III

Smoke, microgrammes per cubic metre for all Volumetric Gauges for 1956-64

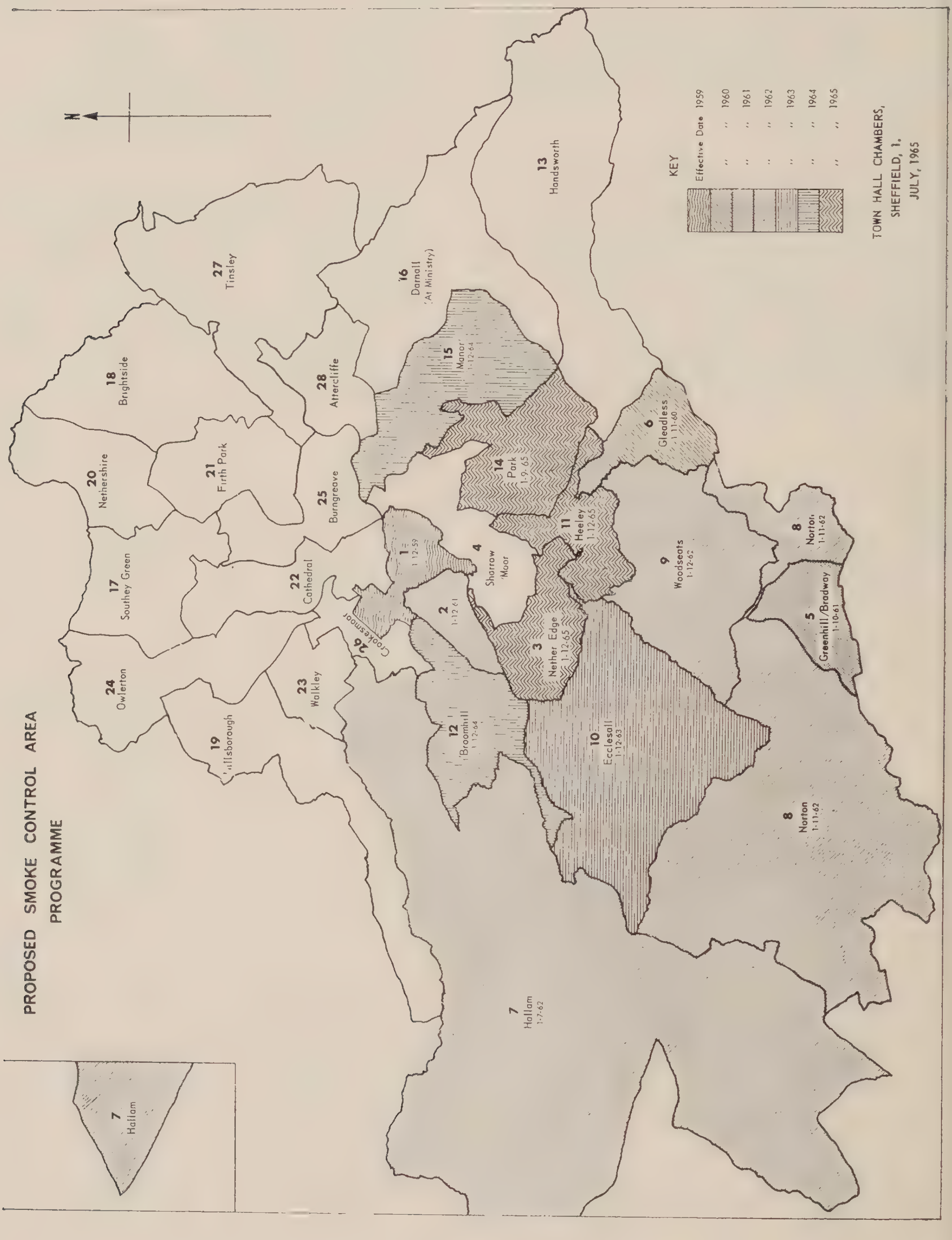
Year	*Smoke*	*Number of Gauges*	*Average per Gauge*
1956	2,610	8	326·0
1957	1,990	8	248·7
1958	2,030	8	253·5
1959	2,550	8	318·7
1960	2,170	8	271·2
1961	1,760	8	220·0
1962	1,700	8	212·5
1963	1,472	8	184·0
1964	1,706	10	170·6

TABLE IV

Sulphur, microgrammes per cubic metre for all Volumetric Gauges for 1956-64

Year	*Sulphur*	*Number of Gauges*	*Average per Gauge*
1956	2,280	8	285·0
1957	2,139	8	267·0
1958	2,342	8	292·8
1959	2,153	8	269·2
1960	1,916	8	239·4
1961	1,659	8	207·2
1962	1,748	8	218·5
1963	1,692	8	211·5
1964	1,818	10	181·8

taken and with co-operation from the house-owners and householders, with help from the industries concerned and encouragement from the local Council, the goal of a clean and sparkling atmosphere for most of the City will be achieved—no more will Sheffield and Smoke be synonymous.



(3) SCUNTHORPE

by

G. O. Allen, M.A.P.H.I., A.M.Inst.P.C,[*]

ABSTRACT

After reference to the industrial problems in Scunthorpe the paper describes the approach to domestic smoke control and the problems encountered and successfully overcome. The value of pollution records is emphasized and the administrative work involved is described. The paper stresses throughout the importance of securing the co-operation of everyone concerned. In conclusion, a number of practical questions are posed, on which comment is invited.

MAY I say at once that it gives me much pleasure to be associated with Mr. Batey of Sheffield. Our respective towns are closely linked together in that they have major iron and steel industries. I know that he himself has enjoyed a personal success story and I take this opportunity to acknowledge the co-operation I have received from him, as well as from numerous other members of our profession who are all concerned with this problem which in a greater or lesser degree is common to us all.

It is pleasing to write of success, but what does the word really mean? One dictionary defines it as "the prosperous termination of anything attempted". The word "successful" is said to be "having, achieving, the desired end or effect, gaining the prize aimed at".

If this is so, there is no success story for Scunthorpe yet. We have not reached a "prosperous termination" of our desired end of air pollution. We are well on the way to the ultimate goal and the prizes we are aiming at are blue skies and pink lungs. We, in this industrial garden town of the north and midlands have as our motto "Refulget — Labores — Nostros — Coelum", which I am informed can be translated as "The Heavens Reflect Our Labours". The consensus of opinion in Scunthorpe is that "the sky will reflect our labours only when the air is clear".

The success story is one of co-operation. A progressive council with clear thinking members has supported the campaign of clean air for many years. The merits and demerits of fuels, costs, etc., have all been carefully considered and the plea of the Chairman of the Health Committee that you cannot put a price on good health has always found a ready acceptance.

The co-operation has been between—

Elected members and officials
Elected members and the general public
Officials and the general public
Officials and appliance dealers, fixers, fuel distributors and last but by no means least, the press.

My own personal experiences with the local press have been most enlightening. The local reporters have shown a complete understanding and knowledge of smoke control problems.

Members of the Council and of the general public have been and are firmly of the opinion that a "heavy industry" town such as ours need not necessarily be a dirty town. The popular adage "where there's muck there's money" attracts little support. Today, we prefer the money without the muck. A successful business man must have a smart "well groomed" front and so must a successful town. If anyone who has not done so, cares to come to Scunthorpe, to visit, live or work, he or she will be well pleased with what is heard, seen, and breathed.

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[*] Chief Public Health Inspector, Borough of Scunthorpe.

Industrial Pollution

Domestic smoke control success is the theme of this paper, but industrial smoke control is so much part of both our towns that I feel that mention must be made of it.

"What are the Works doing?", was a cry heard many times in our early days and it seemed quite easy to say "Ah, well, the Alkali Inspector deals with that". The Alkali Inspector *did* ably deal with that (when he wasn't in Sheffield), so I had to be assured that there was co-operation between the council officials and the officials of the iron and steel industry. The volumes of smoke from coal burning boilers disappeared as modern methods replaced antiquated firing systems. Research on dust arresting equipment has ensured a pink haze now replacing the red fog from the steel furnaces.

The Council has been concerned about industrial pollution for many years.

The following is an extract from the Annual Report of the Medical Officer of Health for 1938.

> "The criteria for adequate air conditions include the comfort of the individual, his psychological and physiological reactions to the atmospheric conditions and his freedom from pathological tissue change due to atmospheric damaging agents. Foul air increases the incidence of respiratory diseases.
>
> "We have got pure water and good drainage, clean streets and modern houses. Now we must purify the air."

In the early days the main problem in the town was said to be pollution from industry. The large amount of dust, fume, and smoke in the air overshadowed the fact that there was such a thing as domestic pollution. In 1938, therefore, monthly deposit gauges to record solid pollution were set up in various parts of the town. The results were such that a special mention was made in the Autumn 1940 issue of *Smokeless Air*—

"It is of course, impossible to make any precise comparisons of conditions in different districts from these deposit records, as so much depends upon the situation of each gauge. A striking example is shown by the extraordinarily high deposit recorded at Santon, Scunthorpe, which is of the order of 2,000 tons per square mile per annum. This gauge is situated 30 feet from a steelworks, with houses, a sewage disposal works, and coke ovens close by".

The average monthly deposit at this station was 174 tons, three times greater than the next highest.

The report in *Smokeless Air* did not emphasize the fact that in the centre of the town, the pollution rate was an average of 23 tons per square mile per month, which compared favourably with other towns in the survey.

The second world war prevented any direct action, but on the cessation of hostilities, steps were taken to have the houses at Santon demolished, and everyone breathed a sigh of relief. Further testing of the air throughout the town by means of deposit gauges continued and there was a general reduction in the level of pollution.

Domestic Pollution

The story of the fight against domestic pollution is also part of my own life. In this narrative, I shall lapse into terms like "I", and "We" or "Us". This is not in any sense "egotism", rather it is an easier way than to mention individuals in the town by name.

Up to 1957, I had personally played a minor role in the prevention of pollution. At that time, the Medical Officer of Health asked me to tackle the various problems of the Clean Air Act of 1956, so I decided that I must know as much as the next person about the subject. Unlike my colleague Mr. Batey, I shall never be able to understand all the mechanics of industry. I was conscious of this in 1957, so I decided, therefore, that the approach to clean air in the domestic field should not be technical but should be from a layman's point of view. I had to convince myself that the lovely coal fire I sat against on the chilly evenings was a death trap for some unfortunate person, and that I could replace coal with other equally cheery and comfortable fuels. To a Yorkshireman, born and bred amidst the mining areas, this was some task, especially with a Yorkshire wife. I can therefore commiserate with my colleagues in mining areas who have had all the worries of "concessionary" coal. I thought to myself, was I putting the miners out of work by denouncing coal? I realized that coal would be a valuable commodity for many years for many industries. I knew that coke and the smokeless solid fuels came from coal. What I could not understand was that coke, which before the war could be obtained for a song, was now costing as much as coal. What I realized and what had been always to the fore, was that coal contained harmful matter which, when sent out into the air via a chimney, caused someone to die prematurely. I knew that when the dirt had gone out of coal we were left with a solid smokeless fuel which produced heat without polluting the atmosphere. I also realized that the gas industry and the electrical undertaking were basically relying upon coal to make gas and electricity. I decided then that the prospects for clearing the air were bright.

The pattern for setting up smoke control areas as described in the booklet "Memorandum on Smoke Control Areas" simplified our approach to this problem.

The map at the end of the paper shows that the iron and steel works are on the northern and eastern boundaries of the town and since the prevailing winds are from the south and south-west, industrial pollution, though heavy, has not been as consistent as domestic pollution. As indicated on the map, these considerations led us to select as the first area the south-western extremity of the town, that is, the area furthest from industry.

The area contained about 1,200 council houses all with approved open inset fires and gas ignition. It can be seen that even in the early days from 1956 to 1958, the thoughts of our Authority had been on smokeless conditions. (The Building Byelaw relating to approved appliances came into operation in 1957.)

The council housing estate was bounded by two roads at right angles and the other perimeters were the boundary to the town with little or no housing in rural surroundings. These two roads contained 260 private houses in which conversions would be necessary.

It was obvious from the generalized pattern of ministerial legislation and instruction that each authority would have to find out for itself all the pitfalls and problems of setting up smoke control areas. Indeed, I am sure that the present knowledge of the civil servants was built up by listening to queries from officials like myself. On one occasion, I even remember a civil servant actually asking me what I thought of a particular matter.

Pollution Measurements

Whilst we were considering which smoke control area to set up, I was rather curiously impressed by a piece of apparatus now known as a Daily Smoke and SO_2 Volumetric Recorder. One was purchased and set up in the former offices of the Health Department which were in the older part of the town. The outlet tube faced on to a road used mainly by bus traffic. To the north-west were rows of terraced houses, and behind the offices were the railway sheds where locomotives were housed and maintained. About 100 yards to the north-east were the gas works and a tar works. The records of smoke stains were visible and irrefutable evidence of the polluted air. Within a few months it was decided that if we were to have a smoke control area, it would be as well to check the air in that area.

So a second daily recorder was set up in the centre of the proposed smoke control area. By various checks we established that during certain weather conditions pollution in the centre of the proposed smoke control area was as heavy as that in the centre of an industrialized area. It was this that first set us on our way to success. When anyone asked why we bothered about smoke control in houses, we showed a series of smoke stains on filter paper which demonstrated this heavy domestic pollution. That was much more convincing than eloquent pleas.

We decided to look further ahead in our check of the pollution of the atmosphere and set up two more daily record stations in different parts of the town. In fact, we practically complied with the requirements of the Department of Scientific and Industrial Research when the National Survey was first broached. We now had four stations.

A. In the centre of a smoke control area.
B. Near to industry.
C. Near to the commercial side of the town.
D. On a pre-war housing estate.

In addition, we were fortunate enough to borrow a 3-hourly smoke recorder which has given remarkable readings at the varying times of the day.

The degrees of pollution are recorded by means of graphs and once again the four graphs for the four stations give visible evidence that the air of Scunthorpe is gradually being cleared.

With a four-year set of figures it has been possible for me to obtain a fairly clear picture of the pattern of pollution. Two conclusions are outstanding.

1. The common sense conclusion that there is more pollution in winter than summer
   and
2. The conclusion that the degree of pollution is reducing *throughout the town.*

I have taken quarterly and annual averages and the reduction becomes very clear in the annual figures. Two tables are shown at the end of this paper.

In order to complete the various records required before a smoke control area could be confirmed and, of course, to check on estimated costs, it was necessary to have a look at the private houses. We had no inspection card or any specific idea what we wanted to know. My Deputy and I (at that time, I was the Deputy and he was the district inspector with the smoke control area in his district) visited some of the houses and discussed fuels, appliances, etc., with the occupants. We were very fortunate in that most of the houses to be surveyed were owner occupied. We aimed at finding out what the housewife wanted and what the husband could afford. We met much opposition. It was not by any means all plain sailing. We got sick and tired of answering the question invariably put to us "What are you doing about the works?". We subsequently built up an inspection card which has not been substantially altered since.

In 1961 a Clean Air Exhibition was held. The various fuel distributors and appliance dealers put on a wonderful show and the number of visitors was very encouraging. A painting competition was devised for the school children and there were some remarkably good entries. I think the Society could well look at amateur efforts for clean air posters, where the idea rather than the painting could win a prize.

By this time we were beginning to make an impact on the local press. We began to get good notices. Letters to the Editor deprecating our work were few and far between. Our first smoke control area was getting under way.

Costing was a bugbear. How long, for example, did it take to put in an approved appliance? and if a builder did six in a row, what should the charge be? I decided to find out in a practical manner. A builder member of the Health Committee allowed one of his workmen to put an appliance into the house of an aged person free of charge. I acted as labourer. From that day we have always asked builders about charges for fixing. We haven't always agreed, but we have been able to fix average charges to work on.

We experienced difficulty in deciding the amount of smokeless fuels we should want for the future. We had to work out therms and kilowatts and tons of smokeless fuel. I think it's about time this was cut out. Estimating what a housewife wants a year before she wants it is rather difficult (Mr. Minister—please note).

Public Inquiry

Eventually, the day came when the area was approved by the Council and passed to the Ministry. The usual notices appeared and here we received what we thought was our first setback. Some people actually objected to what we were doing. Our pride suffered a fall. To think that anyone should have the effrontery to object to what was being done for his own good. Nevertheless, an Inquiry was held in a very pleasant atmosphere. An exceedingly kind gentleman from the Ministry arrived, sat down and commenced his interrogation. Within half-an-hour, he had put me by his side in order that I should identify all the characters objecting. About two hundred people signed the objection form and they were represented by about half-a-dozen good ladies with forthright methods of speech. No punches were pulled and I winced visibly as I was accused of wasting public money, etc., etc. The council's case was ably presented by our own legal department in a manner which I thought revealed a considerable knowledge of the actual subject as well as of the Act itself. Before leaving the town, the Minister's representative, the principal objectors and I toured the proposed smoke control area. About six weeks later we received the Minister's decision. The objections were overruled; we could carry on. It was of course impossible for me and one inspector to do all the work, so it was a question of all hands on deck. Every Public Health Inspector set to and carried out inspections, answered queries, etc. I must confess that for some time, I did little else but smoke control work. However, the Chief Public Health Inspector and the Medical Officer of Health both realized that someone had to be responsible and I seemed to be the obvious choice.

Whilst all the work was going on, the Council's Health Committee formed a special Smoke Control Sub-Committee which I could call at any time to advise me. In the early days they met on many occasions. I never tried to "run the joint" alone. So far I have refrained from personal names, but I feel that I must pay tribute to the first Chairman, Charles C. Watson, who was also a member of the Society. His lively interest, his considerable knowledge and his willingness to consult and advise, were of tremendous help to me. When he retired from Council work, he was followed by Councillor Cyril Nottingham, and the present Chairman is Councillor Jim Beverley. Their names may not ring out to this meeting but both of them have been my sheet anchor in the stormy introduction of smoke control areas.

My advice to public health inspectors is never to try to plough a lone furrow, much good advice can come from sympathetic and understanding councillors. In any case, how can you expect an authority to agree to expenditure if it is not fully in the picture? I can assure you that, contrary to the general impression, the streets of Scunthorpe are not paved with gold. Estimates are very carefully examined, and expenditure has to be justified before it is approved. But any measure to improve the health of the people is looked upon with favour by my Health Committee and by the Council as a whole. Who can say that clean air is not a proven reason?

The early days before and after confirmation of our first smoke control area were exceptionally arduous. The district inspectors helped as much as possible, but it had now become obvious that some other form of assistance was required, for we were receiving many requests from house owners to call and explain the eccentricities of this new legislation. It came to my notice that Sheffield had started a new trend—the employment of female labour. What was good enough for Sheffield was good enough for us. In January 1961 we appointed our lady smoke control assistant, a decision that has never been regretted. We were fortunate in as much as she had been a nurse and had a professional outlook on life. She became the intermediary between ourselves and the general public and, here again, I must express my thanks to Mr. Batey and his assistants for the valuable help they gave her, particularly in matters of procedure.

In 1963 it was realized that if a programme was to be completed within the lifetime of members, something further had to be done. We had divided the town into ten areas, but had discovered that the areas still to be declared were too large for one person to handle. A decision was made to appoint a second lay assistant, and once again we were fortunate in our decision. We appointed a man who had building experience and between the two of them, the work of conversion has progressed very smoothly.

It can be said that little or no opposition has been met with in our operations. We have endeavoured to please the public who have had to have conversions. We have not "rubber stamped" every application. If individual attention has been required for any specific case, this has been given. No problem has been too small. We receive many requests from householders not in smoke control areas, asking if they are entitled to grant. I have found that the bulk of requests are for either gas or electric installations, or central heating. It is unfortunate, in my opinion, that the Ministry feel unable to widen the scope of grant allowances to cover such cases. Obviously, the fuel to be used would be smokeless.

As I have already stated, it hasn't always been plain sailing. Because of our desire to have the full confidence of the public, we have attended to the merest detail and we have encountered many problems, some of which we have settled ourselves and some have been settled by a telephone call to the Ministry, with whom our relationships have always been most cordial.

Questions for Discussion

The experience I have gained over the years has posed a number of questions which, by way of conclusion, I pass to you in the hope that they may at any rate provoke some discussion.

(*a*) Do we all feel that grant could be given outside smoke control areas or do we think it is going to cause too much work?

(*b*) Why can't building byelaws be made compulsory? I know that after the operative date in 1956, many stool bottom grates were still being fixed in new houses, simply because no byelaws had been made by the local authority.

This applies even now with the Housing Act of 1964. New byelaws are supposed to be forthcoming. Surely it should be an offence to put in an appliance that will not burn the fuels of the future.

(*c*) When do you stop giving grants in a smoke control area?

It would appear that if a house has never received a grant, by means of a statutory notice, conversion can be effected two years after the area has been in operation, if smoke is seen appearing from the chimney.

(*d*) Cases are noted where a house in an area has received grant for the "fixing" of gas or electric appliances. Some time after the area has been in operation, the original tenant leaves and takes the "fixed" gas and electric appliances with him. The incoming tenant (probably from another town) then finds that he has to spend more money on top of the purchase price of the house in order to avoid causing any contraventions.

It is not possible to declare that it is illegal to remove *any* appliance from a house in a smoke control area except at the specific request of the incoming tenant. If the appliance was a solid fuel one, it would not be removed, then why allow gas and electric fires to be removed?

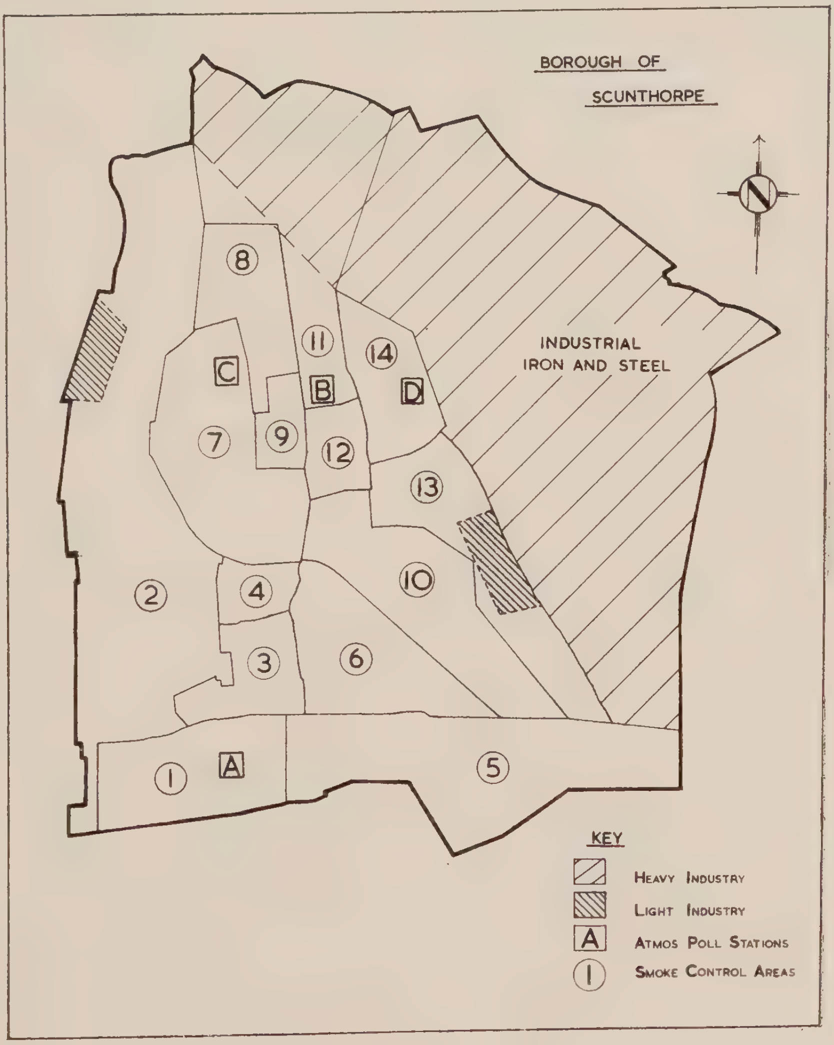
(*e*) The Society have asked for a different apportionment of the grant. Instead of 3-3-4 it has been suggested that 2-2-6 would be more appropriate. In view of the fact that conversion costs are much higher than in 1956, 7, 8 or 9, the 3/10th payable by the owner and by the local authority is considerably higher as can be seen by the following.

Pre-1964: Average cost of conversion was—

	£	s.	d.
2 open insets and fixing	12	10	0
Gas ignition to both . .	7	10	0
	£20	0	0

3/10ths = £6 per house by the owner and by the Council. The cost for an area of 1,000 houses was £6,000. Nowadays the cost could be—

	£	s.	d.
Openable stove and back boiler and fixing	47	0	0
Underfloor draught fire and fixing	22	0	0
Gas point to underfloor draught fire	6	0	0
	£75	0	0



3/10ths = £22.10.0d per house by the owner and by the Council. The cost for an area of 1,000 houses now £22,500. Quite an item for a small authority with a low penny rate. If the Society's figure of 2/10ths was accepted, the amount would be £15 per house or £15,000 for an area of 1,000 houses.

It's all right the Ministry saying that more discretionary grants can be given, but where do you stop? What kind of a "means" test do you apply, to assess whether or not a person can afford to pay any sum at all?

One of our own stories of success comes from the fact that 100 per cent grants have been considered for old age pensioners, persons on National Assistance, or persons with a very limited income (about £7 a week). There are many people in this country who own their own houses but have fallen on bad times and can only earn small incomes—even in Scunthorpe. (*f*) Why can't it be a condition when "standard" or "improvement" grants are given that all the fuel burning appliances in the house shall be capable of burning smokeless fuel?

Finally, I mention my own little problem of block grants. So many people tell me they agree with me, that there must be something in this scheme. I feel that even if I cannot achieve success in getting block grants in smoke control areas, the idea is worth pursuing in non-smoke control areas.

I am well aware that the problems we have encountered are not peculiar to Scunthorpe. They, and similar problems, have to be faced wherever an authority takes steps to rid the air of unnecessary pollution. I have outlined the various steps we have taken to overcome both opposition and obstacles, and if what I have said has been of any value and assistance to other members, my paper has been eminently worth while. When the day arrives that this country of ours can tell the world that all its towns and cities have clean air above and around them, we as Health Inspectors shall have made yet another vital and impressive contribution to the health and happiness of our people.

Station	Average	1960	1961	1962	1963	1964	*Position*
A	Quarter	88 66 47 87	117 37 20 110	75 75 44 86	110 65 52 71	90 60 56 81	Centre of first Smoke Control Area
	Half-Year	77 67	77 65	75 65	88 61	75 69	
	Annual	72	71	70	75	72	
B	Quarter	265 98 64 140	210 90 71 203	188 113 109 162	182 71 78 151	195 76 66 142	Industrial
	Half-Year	182 102	150 137	151 136	127 115	136 104	
	Annual	142	144	144	121	120	
C	Quarter	191 113 111 228	240 104 62 245	256 144 123 209	249 99 89 192	252 78 93 179	Com-mercial
	Half-Year	152 113	172 153	200 166	174 141	165 136	
	Annual	132	162	183	158	151	
D	Quarter	—	200 76 54 248	210 107 93 111	85 54 64 80	66 56 70 97	Pre-War Council Estate.
	Half-Year	—	138 151	159 102	70 72	61 84	
	Annual	— —	145	131	71	73	

Average Figures from Daily Smoke Readings in Scunthorpe (All Figures in MG per M^3)

Station	Average	1960	1961	1962	1963	1964	*Position*
A	Quarter	180 47 53 153	87 59 63 141	105 36 30 90	102 39 29 63	65 29 29 73	Centre of first Smoke Control Area
	Half-Year	114 101	73 102	70 60	70 46	47 51	
	Annual	108	90	65	59	49	
B	Quarter	293 113 100 210	183 100 89 199	219 87 83 207	198 64 60 164	173 56 49 122	Industrial
	Half-Year	203 155	142 144	153 145	131 112	115 86	
	Annual	179	143	149	122	101	
C	Quarter	150 120 100 294	224 116 107 267	281 119 91 285	306 107 94 238	270 89 72 187	Com-mercial
	Half-Year	135 187	170 187	200 188	207 166	180 130	
	Annual	161	179	194	187	155	
D	Quarter	—	143 72 82 189	193 93 78 252	200 79 77 172	158 77 55 147	Pre-War Council Estate
	Half-Year	—	108 136	143 165	140 125	118 101	
	Annual	—	122	154	133	110	

SOLID FUEL DISTRIBUTION AND SUPPLY PROBLEMS (1)

by

*Eric Otty**

ABSTRACT

Methods of delivering solid fuel have not changed materially over the last century. Largely as a result of the re-organization of British Railways a a number of fully mechanized distribution depots are now in operation. The paper describes some of these depots and emphasizes their importance in the drive for improved efficiency in the field of transport and distribution.

1. DURING the last two years there has been considerable re-organization of the methods of distribution of solid fuel for the domestic market. The impetus has come from two directions—the shortage of labour willing to load fuel manually and the concentration programme of British Railways.

2. The arguments for concentrating stations traffic were clearly set out in "The Reshaping of British Railways" (The Beeching Report of 1963). At that time there was about 28 million tons of mainly domestic coal, coke and patent fuel traffic worked to about 5,000 stations throughout Great Britain. This fuel was sent out from collieries, coke ovens and gas works in individual wagon loads to thousands of merchants. The wagons were made up into trains at a marshalling yard, then moved on in trains to a point where they were broken down and the wagons shunted into a multiplicity of sidings. The Report showed that the cost of this type of movement was about twice as much as through train movement from a production source to private sidings. An examination of the flow of this domestic fuel showed that of the 5,000 stations involved, over 3,000 received less than 5 wagons per week. A very large number received no fuel at all, although they were open for this traffic. The average radius of distribution from these stations was about 2½ miles; the stations had been established at the time when the journeys were done by horse and cart. The Beeching Report postulated that if the trading radius could be increased to 10 miles (a journey practicable with motor vehicles) the country's domestic solid fuel needs could be provided from about 250 centres. On average these centres could handle about 100,000 tons per annum; a tonnage which could be worked in train loads from collieries and coke ovens etc. without all the shunting, marshalling and tripping. The resulting reduction in rail transport costs would be very considerable, and the Railways offered to pass on part of their savings to enable this concentration programme to be implemented.

3. The Organization for concentrating coal traffic was set up at the end of 1962. It was then agreed that Tripartite Committees consisting of representatives of the National Coal Board, British Railways and the Distributive Trade should be set up at national, regional and local levels to implement the concentration programme as quickly as possible. As a result of early discussions at national level, certain principles were established to ensure that merchants' trade was not dislocated and there would be no

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* Head of Special Projects Branch, National Coal Board.

hange in retail prices. Although merchants have had to move their place of work, there has been practically no interference with householders' supplies. Although the broad concept of working a 10 mile radius rom a central depot was right, it is not practicable in the crowded urban area with the dense traffic conditions. By June 1965 some 270 concentration depots had been established to handle about 7½ million tons per annum and the number of stations receiving coal class traffic had been reduced to about ,000. It looks as though the ultimate will be concentration to 4/500 centres.

4. Most of these concentration depots are in effect centralizing the receipt of fuel and merchants continue to operate in the traditional manner. This simple type of concentration has enabled the Railways to close stations releasing in some cases valuable sites for development. Now that larger tonnages are being handled in these concentration depots there is more scope for mechanization which is being gradually introduced, usually in the form of grabs and mechanical shovels for discharging wagons and portable hoppers for sack loading. At some concentration depots the traffic is forwarded to a "single consignee" who arranges for rapid discharge of trainloads and stocking of the fuel for the other merchants on the yard. There are also concentration depots in rural areas from which the fuel is transported in bulk lorries to merchants some distance away.

5. The most interesting outcome of the concentration programme, however, has been the establishment of large fully mechanized depots mainly in the southern part of the country. These handle upwards of 75,000 tons per annum, and are only made possible because the Railways are prepared to grant substantial rebates on trainload traffic over relatively long distances. Some ten mechanized depots of this type have been completed, ten more are either under construction or have been approved and some thirty more are at various stages of planning. The planned capacity of these mechanized depots is about 5½ million tons per annum. Some of these depots are owned by the National Coal Board and some by large merchant firms who provide a similar service for the other merchants in the trading area of the depots. British Railways also own a mechanized depot at Taunton (Somerset) which is managed by a distributive firm.

6. The first of the fully mechanized depots to be established by the National Coal Board under the concentration programme was at West Drayton in Middlesex. A plan of the depot is shown in Fig. 1. The depot which was completed by the end of 1963 was designed to handle about 200,000 tons per annum and is currently supplying this tonnage to 102 merchants, operating within an 8 mile radius. There are 20 different qualities of fuel available all the time including 15 grades of smokeless fuels which account for about half of the total trade. The fuel is made available from 48 hoppers which are fitted for mechanical sack loading and 12 hoppers which are used for bulk loading into autobaggers or tipping lorries. The merchants who trade at the depot formerly carried on their business from some 30 stations which have been closed. The fuel is brought to the depot in scheduled trains of 35 or so 21-ton hopper wagons and it is possible for a trainload to be discharged each day. The flow of traffic is even throughout the year and what is not wanted for immediate sale is put to the stockground which can hold about 40,000 tons. This tonnage is accumulated during the summer and supplements the receipts during the winter months, when demand is at its peak. Merchants order their requirements daily and can promise with certainty the precise time when delivery can be made to a householder. There is no difficulty in drawing supplies of several different fuels at the same time and this is the general practice among the smaller merchants to make up mixed loads.

7. The trade of this depot is in a densely populated area but in the

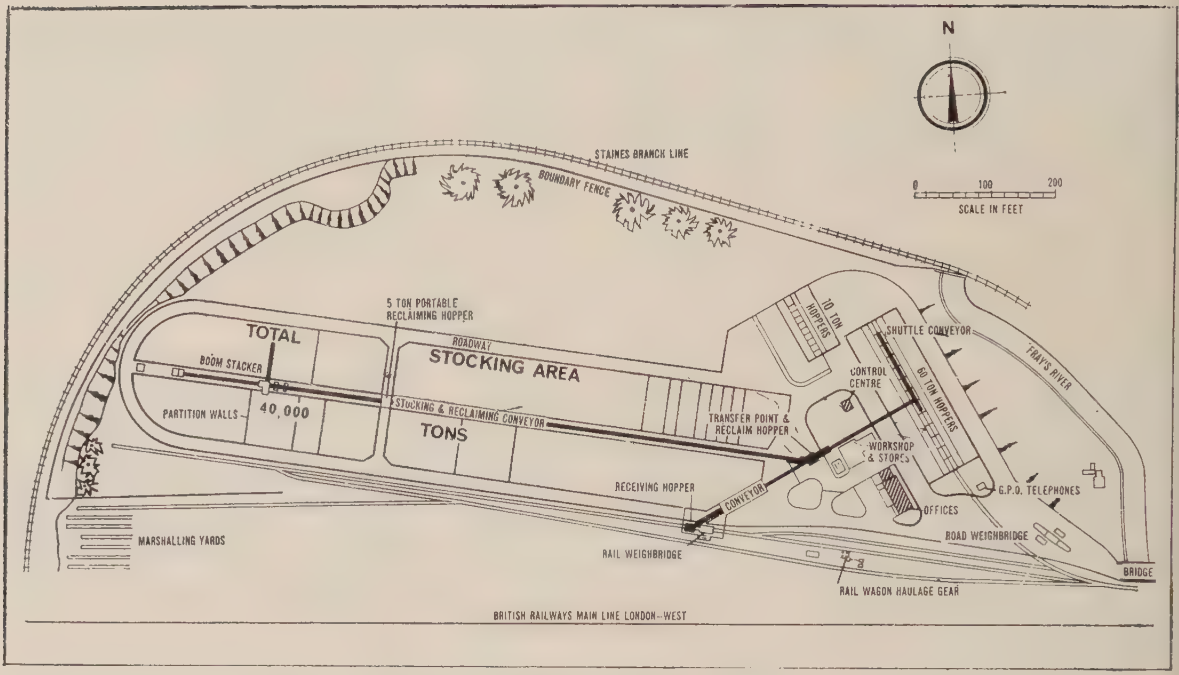

Fig. 1

rural areas the fuel has to be carried longer distances from such mechanized depots and in these cases more facilities are provided for bulk loading into either autobaggers or tipping lorries for the smaller merchants yards. There are various engineering concepts which have been employed as each depot is designed specifically to suit the local trade requirements. The basic requirements of the mechanized concentration depots are facilities to discharge a trainload of fuel in a day, conveyors to transfer the fuel to hoppers for bulk or sack loading and means of stocking out and recovery from the stock ground. Simple systems can be devised where a depot is being used by a single trader who has full control over the vehicles using the depot, but much more elaborate equipment is required for a depot designed to provide a "supermarket" service to a large number of merchants who want to collect fuel at any time to suit themselves.

8. The second of the National Coal Board's depots was opened at Luton (125,000 tons per annum) in July 1964 and the third was opened in Spring 1965 at Tolworth, Surrey (125,000 tons per annum). The latter is a "radial" scheme—the fuel being discharged from the wagons onto a conveyor mounted on a 280 foot boom which travels to feed the fuel into 18 hoppers disposed radially. The end of the boom can also be lowered to ground level to put the fuel to stock as shown in Fig. 2. This type of depot is very economical

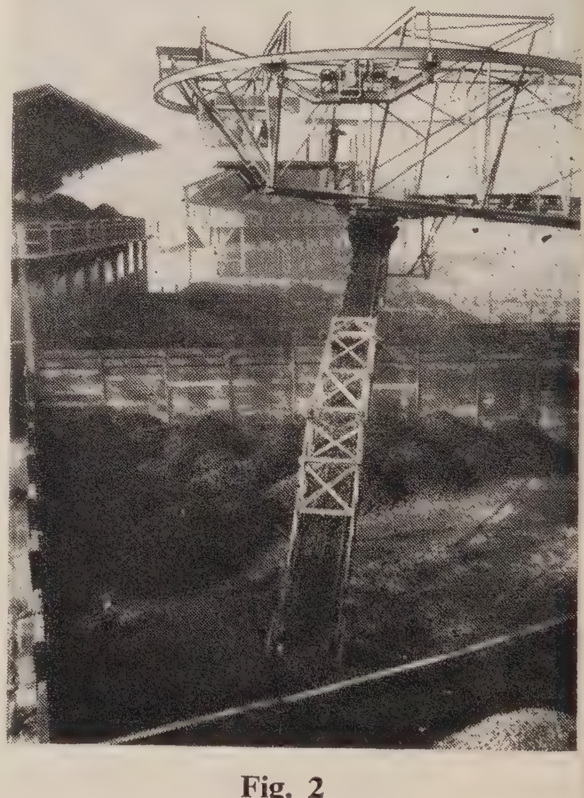

Fig. 2

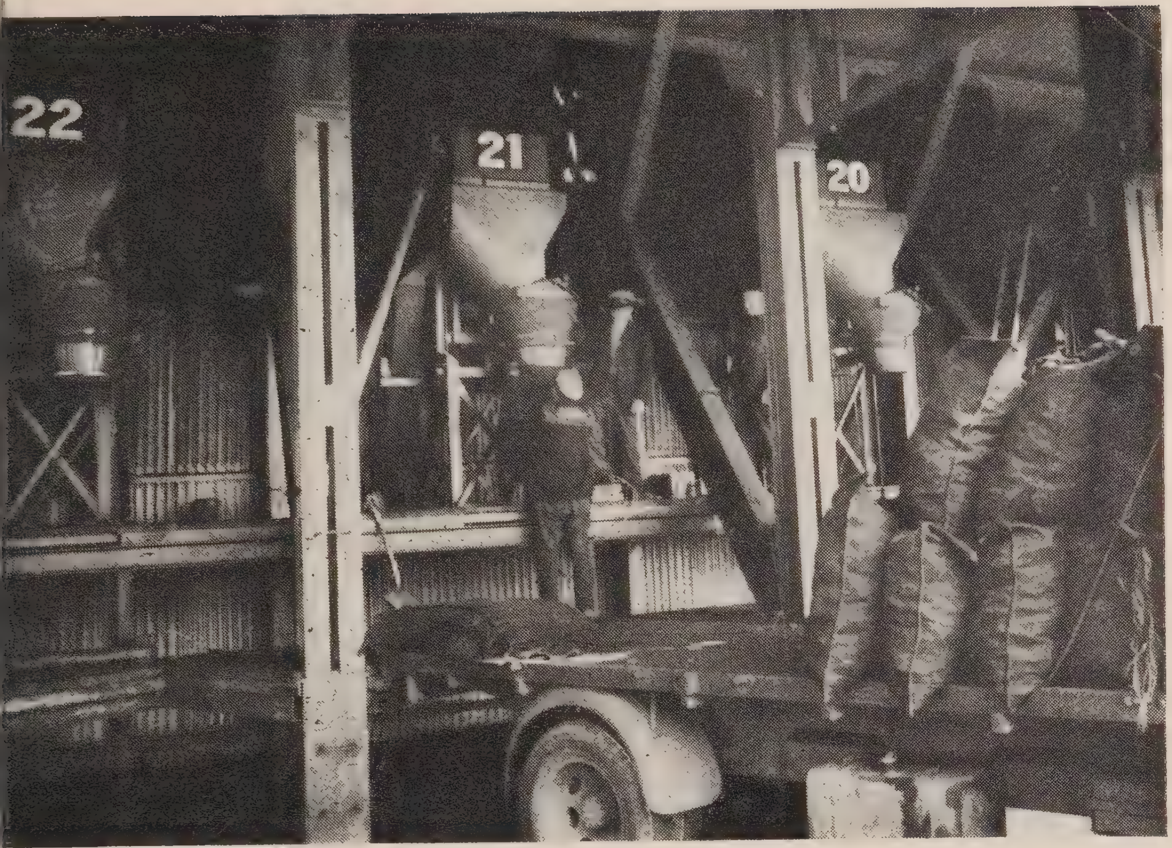

Fig. 3

and flexible but requires a suitably shaped site and the size of the stockground is limited. Other depots are under construction for the National Coal Board at Aylesbury (120,000 tons per annum); Crawley, Sussex (100,000 tons per annum); Wolverton, Bucks. (80,000 tons per annum) and Watford (150,000 tons per annum).

9. The merchant who draws fuel from mechanized concentration depots pays a service charge for the facilities, which is related to savings which are made through being relieved of the cost of running his traditional yard. All merchants trading at a mechanized concentration depot draw from the same range of fuels, and pay the same price for the individual qualities. The merchants therefore compete on equal terms. The small merchant is provided with facilities which he could not possibly afford himself, and the real competition is in delivery service.

10. As well as the obvious benefits of these depots, there are two which will be of particular interest to local authorities. This type of depot can be kept clean and should not be a source of dust nuisance. Roadsweepers should be in use regularly to sweep round the stockground and water sprays can be fitted at transfer points on conveyors for use as necessary. Supervision of this aspect is of course much easier than when dealing with twenty or so depots in station yards, and so is the supervision of weighing practices. The latest types of weighing equipment are incorporated in these mechanized depots. At West Drayton the loaders manually weigh their own fuel after making allowance on the scale for the net weight of the sack. Experience at other depots, however, suggests that weighing a net amount of fuel into a container before discharging into the sacks is the more satisfactory method. At the Luton depot the loader controls the flow of fuel into the net weight containers but at Tolworth, the fuel is automatically weighed. The method of loading sacks at Tolworth is shown in Fig. 3. All the fuel taken in sacks from these depots is screened immediately before loading so that the fuel delivered to the householder is free of dust.

11. There is an increasing interest in

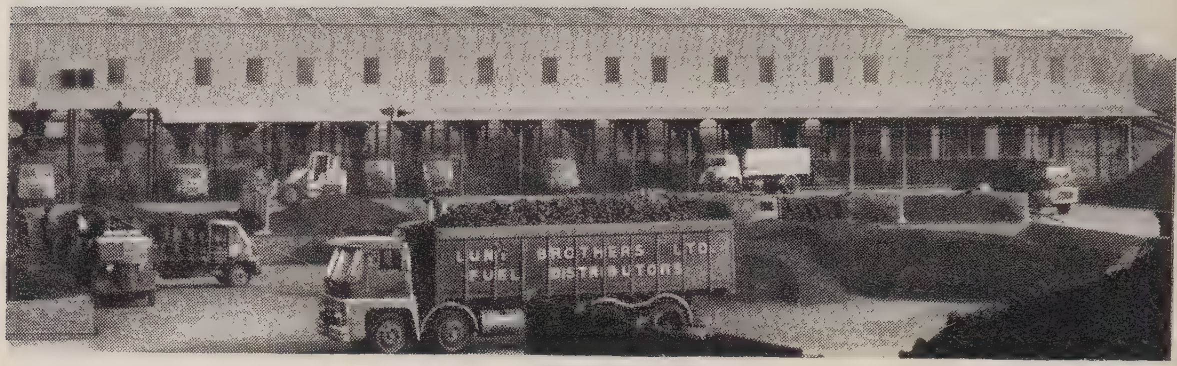

Fig. 4

pre-packing of solid fuels to give the housewife a cleaner delivery service. The main demand for this type of delivery is in times of short supply and it is in the first three months of the year when most pre-packs are sold. Many of the larger merchants now operating plants are anxious to develop trade round the year with a view to more economical operations. Pre-packing offers great possibilities but extension of this method of delivery depends on the supply of cheap non-returnable containers which will hold solid fuels and can be stacked. At the mechanized concentration depot of Lunt Comley and Pitt Ltd. at Pensnett, Staffs. (see Fig. 4) supplies of pre-packed fuel are available as well as sack and bulk loading facilities. Pre-packing plant can be easily fitted into mechanized depots and it is a development which seems likely to continue in the future as most of the fuel now being sold to the domestic market is of a size suitable for pre-packing.

12. The mechanized depots will play a very important part in the drive for improved efficiency in the field of transport and distribution. Moving the fuel from production source to the householder's cellar is expensive and accounts for some 40 per cent of the average retail price. At our collieries productivity continues to increase as machines are more effectively used. At the other end of the line we have solid fuel appliances which are both very efficient and attractive in appearance. We must now ensure that the fuel is transported and delivered to the householder as efficiently as possible and mechanized depots are a very important link in the distribution chain.

Fig. 1—Layout of the Concentration Depot at West Drayton, Middlesex.
Fig. 2—Swivel conveyor at the end of the loading boom at the Tolworth depot. The conveyor can be raised to feed fuel into the loading hoppers or lowered to ground level for stocking.
Fig. 3—Sack loading at Tolworth. Each loading point is fitted with automatic net-weighing equipment.
Fig. 4—The Pensnett (Staffs.) depot of Lunt Comley and Pitt Ltd., which handles about 100,000 tons of solid fuel a year and is a main centre for distributing gas coke.

SOLID FUEL DISTRIBUTION AND SUPPLY PROBLEMS

by

W. H. Bourne[*]

The paper discusses the difficulties arising from the distribution of solid smokeless fuels, from the depot to the consumer, and the changes that have taken place in recent years, especially in relation to consumer requirements. The problems of handling, transport and delivery are considered, together with other matters of importance, including the packaging of solid fuels and the special case of storage and delivery in flats, the Weights and Measures and the Merchandise Marks Acts, and the question of finance.

DURING the discussions which led up to the preparation of this paper it was agreed that Mr. Otty should deal with distribution from the point of production to the point where the merchant received his fuel, paying particular attention to the growth of Concentration Schemes based on the Beeching Plan. This Paper endeavours to cover distribution from the Depot to the consumer, and includes reference to distribution from Gas Works. (Fig. 1).

Whilst the title of the paper allows mention of all types of solid fuel an effort will be made to pinpoint the special difficulties arising from handling solid smokeless fuels.

The post-war period has seen a remarkable change in the habits of consumers, in their social activities and in their economic priorities. At the beginning of this century the 'home' was the pivot of social and economic life and heating the home ranked high amongst the necessities. Most homes depended on solid fuel for heating and a large percentage required solid fuel for their cooking appliances.

What a different picture presents itself today. Very few homes use solid fuel for cooking and there is a ding-dong battle going on all the time amongst the competing interests in the heating field. The competitors direct consumers' attention to:—

(1) the attractiveness of their product;
(2) economy in labour;
(3) control of heat output, and
(4) prestige.

This has brought about many changes and those changes have given rise to a number of problems directly concerned with the consumer. These include:—

(1) The Uneven Demand

In the late twenties I undertook a national survey of retail consumers' fuel requirements. I found then that the average working class household throughout the country spent approximately the same amount annually on solid fuel. In the north several tons of fuel were purchased and used, prices were low and fires were kept burning all the year round. In the south less fuel was bought but the prices were higher and fires were not in general use during the summer. During the war this situation was recognized and the householder in the north was permitted to acquire 50 cwts. of house coal annually, whereas the householder in the south was limited to 34 cwts. per year.

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[*] Executive Officer, National Federation of Coke Distributors' Associations.

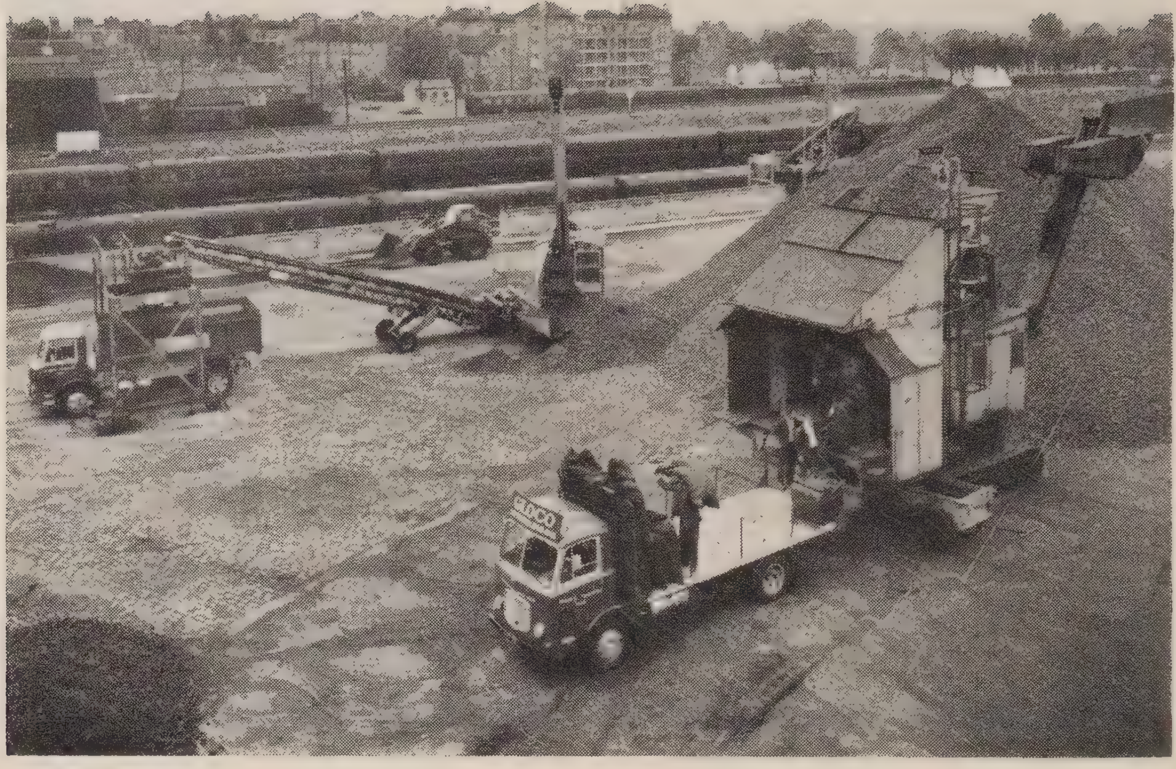

Fig. 1—Loading from stock at one of the North Thames Gas Works. The picture shows on the left, fuel passing over a conveyor belt to a hopper and from there into a tipper lorry loading bulk supplies. On the right there is a mechanical shovel feeding a movable hopper, which in turn supplies a bagging unit

With the development of gas and electricity for cooking, and with the introduction of immersion heaters and gas appliances for the heating of water, the necessity for a continuous solid fuel fire diminished. By the end of control period 1958 many householders were not requiring the full permitted quantity. Some consumers now rely on gas or electricity for space heating to a greater extent except in the coldest of weather when the piped fuels become subject to power cuts and the solid fuel trade tends more and more to be directly related to weather conditions. The direct result of all this is that a merchant is no longer able to estimate his customers exact fuel requirements. In the south the merchant endeavours to provide a cushion by stocking in the summer and working partly from current supplies and partly from stock when the demand from the public is high. In the areas nearer the collieries the necessity to stock is not so great, but it must be obvious that fuel merchants are not able to adjust their receipts of fuel to conform with prevailing weather conditions. This however, comes primarily under the heading of Depot difficulties which we shall consider a little later.

The real point that I want to make is that whereas in my younger days a great deal of the fuel trade was based on some form of weekly or periodic delivery, much of which, particularly in the north, ran the whole year round, today the trade is mainly seasonal and consumers order when they require fuel, in many cases leaving their ordering until they are right out of supplies.

(2) Quantity

The orders show a marked change in the quantity for delivery at any one time. The older houses were built with good accommodation for fuel in coal-houses or cellars, and consumers were inclined to lay in stocks when the fuel was readily available and prompt and satisfactory delivery could be ensured. Now those consumers who would like to make provision in the summer are frequently faced with extra expenditure to provide the accommodation required since the modern house has comparatively small space allocated for fuel storage. This is a problem to which the attention of local authorities has been drawn on many occasions, but it still appears to be low down on the list when housing plans are being considered.

(3) Quality

The history of the solid fuel trade will make fascinating reading for students in the next century. It will show the changing pattern in the social life of the twentieth century from the period when anything which burned was thrown on the large open fire—through the periods of fuel shortage when new appliances were designed to operate on particular types and sizes of fuel more readily obtainable than the normal household types—to the passing of the Clean Air Act and the development of a wide selection of solid smokeless fuels.

The records will show that the producers and distributors of solid fuel in co-operation with appliances manufacturers set out to improve the efficiency of the solid fuel appliance. They will also show that the effort to do this resulted in a demand for a variety of sizes and types of fuel and that this in turn changed the pattern of the fuel distributor's business. Old price lists issued by merchants show four or five qualities, but the modern fuel merchants now list upwards of twenty qualities. The Coal Utilisation Council and the Solid Smokeless Fuels Federation have jointly issued a guide to try and ensure that the right size and type of fuel is used in each consumer's appliance, but the human element sometimes causes the wrong fuel to be ordered or delivered. The consumer frequently blames the fuel and decides to transfer to another form of heating without informing his supplier or taking steps to see what has caused the trouble.

Alongside this change has been the increased attention given to home heating. The Housewarming plan of the National Coal Board and the general direction of attention to the advantage of central heating have lessened the demand for fuels for the open fire and increased the demand for fuels for boilers and similar installations. Consequently there have been periods when the demand for the various types of boiler fuel has exceeded the supply. Since some of the fuels are not interchangeable there have been delays in meeting consumer requirements, but under the Approved Coal Merchants' Scheme and the Authorised Coke Distributors' Scheme every effort is being made to minimize delays and produce consumer satisfaction. Where fuels are interchangeable consumers should be urged to give greater freedom to their merchants and to experiment.

One of the most noticeable changes in consumer demand has resulted, in my view, from the more affluent position of the average householder today. Price is no longer the dominating factor although it plays an important part. Consumers will not put up with inferior fuel at a lower price since they have come to recognize that they obtain greater satisfaction from fuel which has been properly prepared and marketed.

Nevertheless this has brought problems since, at certain times of the year, it has created a demand for the premium fuels in excess of their production. This has been most noticeable in the field of solid smokeless fuels. The work of the National Coal Board in producing the new fuels Roomheat and Homefire is to be commended, but it should not be overlooked that the Gas Boards in co-operation with the Coke Distributors' Associations sought to meet this growing demand in Smoke Control Areas by producing standard fuels marketed under the names of 'Gloco', and 'Sebrite', in addition to the premium fuels 'Cleanglow', and 'Phimax', and that the Coalite and Rexco Producers have also played their part in stepping up production of the premium fuels.

The Hard Coke Producers by their policy of standardizing their domestic coke under the name of 'Sunbrite' helped considerably in the effort of the solid fuel trade to provide a satisfactory fuel for boilers and room-heaters. The developing market for room-heaters has been supplied partly by Sunbrite, partly by the natural and manufactured products of the National Coal Board South Western Division and partly by the correctly sized gas cokes, but there is still much to be done to educate the consumer in the right choice of solid fuel.

(4) Delivery Times

With so many wives out at work all day many homes are left unoccupied during the day and this creates problems for the distributor. Many consumers ask for delivery on Saturday mornings, and such requests are difficult to honour when delivery men are equally anxious to attend the local football match or go shopping with their wives. Then too many people ask for delivery to be made within specified times. During periods of heavy rain or snow it should be recognized that it is almost impossible to maintain time schedules. The reputable merchant will do his best to meet his customer's requirements but some flexibility is essential if a proper service is to be maintained.

The next group of problems to which I wish to refer is concerned with the physical handling of the fuel.

(5) Manual Labour

There are very few parts of the country where labour is freely available and since fuel distribution involves physical activity, with heavy demands in bad weather conditions, it is not so attractive as many other jobs. Consequently it is often difficult to obtain employees of the calibre and character desired. In order to overcome this difficulty many distributors have introduced some form of mechanization into their depot working and have endeavoured to reduce the amount of physical labour involved. Larger merchants with private sidings have erected cover so that their loaders will not be affected so much by inclement weather conditions.

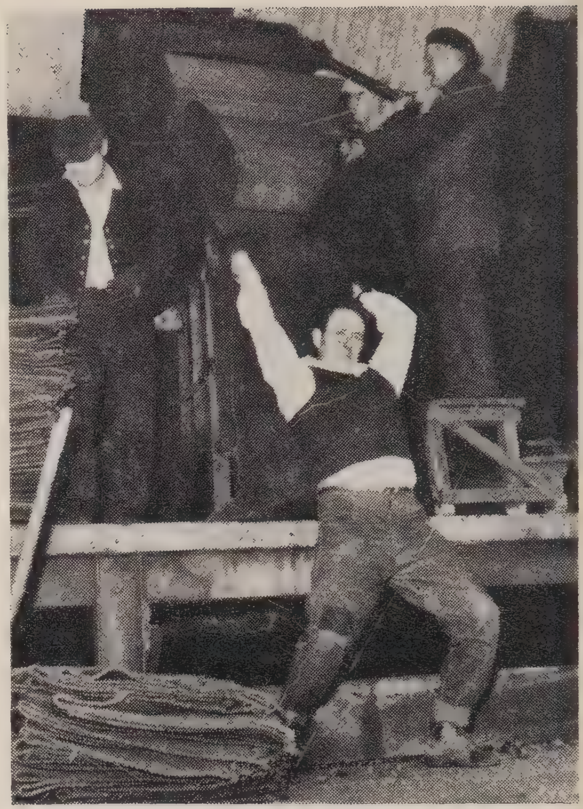
Fig. 2—Loading coke at a North Thames Gas Works

In his paper Mr. Otty has outlined the operation of the Mechanized Concentration Depots and this may give a lead to future planning. Nevertheless, for some time there will continue to be a large number of small depots where for various reasons it will be impractical to mechanize to any great extent and I believe that as long as full employment continues it will be difficult to attract the right kind of labour to solid fuel distribution in such areas. (Fig. 2).

It should not be thought, however, that steps are not being taken in other directions by distributors as employers. Improved holiday terms, sickness pay, and general amenities are being negotiated and the whole question of payment is under constant view. In general the relationship etween the Trades Unions, repre-nting the men employed in fuel stribution, and the Merchants is ne of understanding and co-operation. hen a spirit of goodwill prevails it much easier to find a solution to ny problem.

) Methods of Delivery

Earlier in this paper I referred to a urvey I made of the fuel distributive ade in the nineteen-twenties. At that me it was quite usual for fuel in the orth of England to be delivered oose, leaving the householder the ob of moving the coal from the road r pavement to his coalhouse. Now, f course, with the growth of traffic nd the introduction of local bye-laws ontrolling off-loading of goods, the ractice is uncommon except in a few olliery areas. The usual method is to eliver fuel in containers—in general acks—except when delivery is made o large consumers or industrial works. ven in these cases sacks are frequently sed. Whilst the use of containers has een beneficial, particularly to the onsumer who is able to check receipt f the proper quantity more easily, it as brought other problems. Some reas by tradition have supplied coal n other than 1 cwt. quantities, e.g. ondon 2 cwts.; Hull 1¼ cwts.; ewcastle ½ cwt., and again by radition the size, shape, and sack aterial have varied in different arts of the country. Some areas, for xample, use rope handles, others se lugs; some areas insist on having arred or specially prepared sacks, n others the men prefer to use ntreated sacks.

The lighter solid smokeless fuels equire a different size of sack from hat required by the denser bituminous oals. Traditionally again some bye-aws have permitted coal sacks to be oaded with half the quantity marked hen loaded with smokeless fuels, i.e. cwt. of Coalite or coke in a cwt. oal sack. You may ask why is this a roblem. The answer is twofold. hose men who are paid on piece ork or who have tonnage bonuses as part of their payment, lose income when loading and delivering solid smokeless fuels since it takes longer to fill and deliver the lighter fuels; and secondly the merchant's vehicle is not able to carry as much sacked light fuel as when it is loaded with coal, and the merchants' costs of delivery are therefore greater.

It should not be overlooked that there has been a saving in time and cost when coke is loaded in sacks and it is somewhat unfortunate for the distributive fuel trade that by closure of Gas Works the number of points at which these facilities were available has been reduced.

THE CHARROLD AUTOBAGGER FOR COAL & COKE
CHARROLD LIMITED
40 TRINITY SQUARE LONDON E.C.3.

Fig. 3—*The Charrold Autobagger*

Mr. Otty has pointed out that railway concentration has resulted in the provision of centralized depots. Where these have been mechanized and sack loading facilities provided some of the merchants' labour problems have been overcome, but not all.

(7) Transport

Another new feature in fuel distribution is the development of different forms of mechanical transport. Some

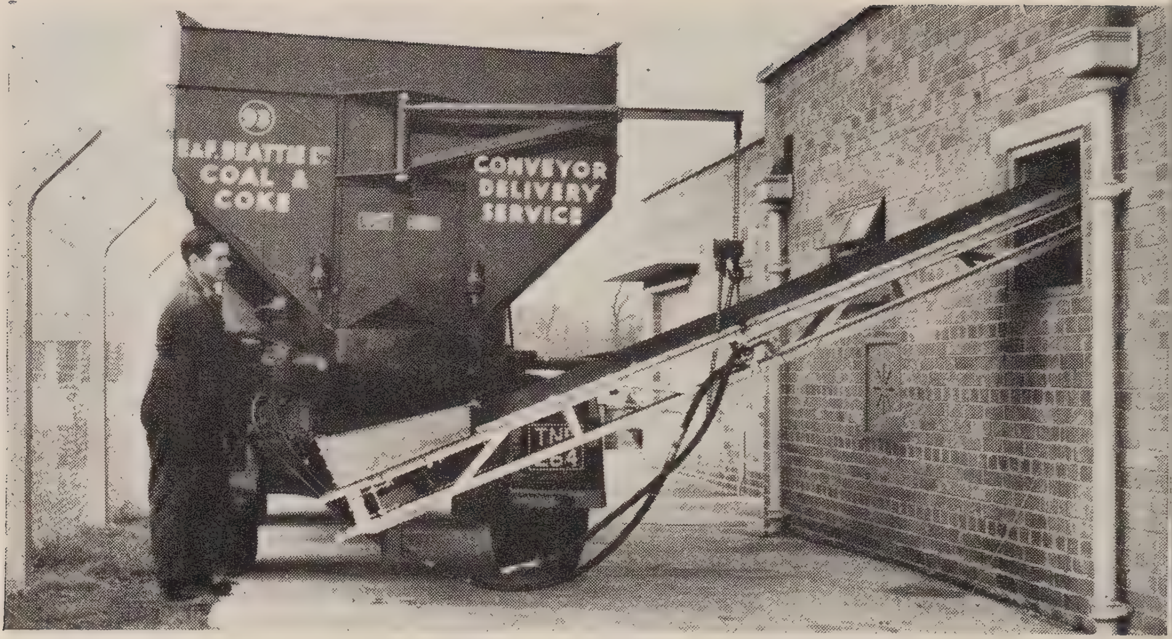

Fig. 4—Delivery by conveyor lorry where the fuel passes from the vehicle direct to the consumer's store without the fuel being physically handled

years ago experiments were carried out in the use of articulated lorries. The driving cab would take one load and leave it at the point of distribution and then return to base for a further load. Other modern equipment is provided by the Charrold autobagger, (Fig. 3) which loads fuel in bulk at the depot and bags it outside the customer's house under the customer's supervision if desired. Then there is the conveyor lorry. Delivery by conveyor lorry means that the fuel is carried over a travelling belt from the vehicle to the fuel store. (Fig. 4).

(8) Packaged Fuel

Because of the changing pattern of demand, and the smaller storage space, special consideration has been given to supplying fuel in small quantities. This is a very expensive method of purchasing fuel, but it is convenient for flat dwellers and for those who run out of fuel during the most severe weather. Fuel is supplied in 14 lb., 28 lb. and occasionally 56 lb. paper bags which are not returnable. Some distributors have erected vending machines from which consumers can obtain a bag of fuel at any time of the day or night.

During May of this year a Coal Handling Exhibition was held at the Marylebone Freight Depot of British Railways and this enabled many people to see at first hand what was being done by mechanization both at the Depot and in conveying fuel to the public.

(9) Flats

Brief reference has been made to another physical problem which is facing the solid fuel distributor, namely how to provide a service for flat dwellers, particularly to those above the first floor. Recently a survey was made of this problem and the following difficulties were recorded:

(a) lack of storage space;
(b) difficulty in reaching the fuel store — the men had to go through the kitchen of the flat to reach the store;
(c) no lift, or not allowed to use the lift;
(d) difficulty of entry to the flats;
(e) vehicle parking problems—the coal lorry not allowed to enter the precincts of the flats and in some cases causing the delivery men to carry each sack as much as 100 yards to reach the staircase.

It is small wonder that delivery men object to conditions such as these. Nevertheless, the distributive fuel trade will continue to consider what can be done to provide a satisfactory service for flat dwellers.

(10) Traffic and Unloading Problems

Another problem, particularly in towns, is associated with the movement of traffic and the necessity to off-load at certain times of the day. It is sometimes overlooked that concentration of rail traffic means also "concentration" of road traffic and this in turn may mean delays in delivery to consumers, particularly when traffic from the concentration scheme depot is having to cross a number of main roads. London merchants in particular have come up against the off-loading regulations, and in some cases have had to park their vehicles some distances away from the consumer's premises, or they have had to arrange delivery during the hours of darkness. Local Authorities could ease the position considerably if they would allow some flexibility for solid fuel deliveries.

Fuel distribution in the main is undertaken by private enterprise, but whether the distributor is one of the nationalized industries, a Co-operative Society, one of the large multiple firms or a small trader he has to conform to rules and regulations laid down by the Central Government and sometimes to additional regulations introduced by the Local Authority in which he trades. Whilst many of these regulations are designed to safeguard the consumer, they sometimes restrict the efficiency of the distributor and give rise to further problems, some of which are outlined in the remainder of this paper.

(11) Weights and Measures Act

Some of the provisions of the 1963 Act became operative at the end of July of this year and certain of these eased the burden of the distributor. He is no longer required to carry scales and weights on his lorry. On the other hand if he uses containers such as sacks for conveying the fuel to the customer these have to be capable of loading specific quantities and have to be marked or tallied with letters and figures of specific sizes. A deliverer is required to carry certain documents which are made out in advance and signed by an authorized person. Whilst it is no longer necessary to print certain extracts from the previous Acts on the delivery note, it is compulsory to show the type of fuel. It is too early yet to assess whether the new Act has created new problems but regulations, however desirable, involve the human element and bring restrictions which hamper ease of operation.

(12) Merchandise Marks Act

The producers of solid fuel are very jealous of the good name of their fuel and have self imposed standards of quality such as the group number for domestic house coal, the grade of anthracite, and the patented name of the various solid smokeless fuels. It is generally known that the British Standards Institution has established a standard for open-fire coke, has under consideration a standard for cokes for boilers, and is investigating a standard for premium smokeless fuels. From time to time various organizations have attacked the solid fuel trade alleging that the consumer is deliberately given a raw deal. Such attacks overlook the fact that solid fuels all originate from a natural product which varies in characteristics. In pre-war days a fuel producer was able to call his fuel by whatever title he chose, and even the size classifications did not conform to the same size pattern in different coalfields. Domestic fuel was usually sold under a broad classification such as "Best Brights" or "Selected Nuts". Individual distributors coined their own classification and registered names to suit their particular trade. In some cases these names were by agreement with a particular colliery group and the customer could be assured of receiving the same quality at each delivery. If the merchant ceased to obtain satisfaction from a particular colliery or group he transferred his custom to another colliery. With the advent of nationalization the pattern changed: there is only one source of supply of coal, the National Coal Board.

Now it must not be overlooked that the National Coal Board was born at a time of fuel shortage and that for many years after its arrival its main purpose was to produce quantity, with quality as a secondary consideration, and in consequence one of the earliest requirements of the new nationalized industry was the need for interchangeability of fuel. It became necessary, therefore, to group those fuels which provided similar results even though such fuels differed somewhat in characteristics or size. During recent years the process of grouping has continued by general agreement between the National Coal Board and the distributive fuel trade. With the improvement in preparation and the attention given to marketing, quality has now become of primary importance and every effort is being made to ensure that the right fuel reaches its proper market.

For many years gas coke was looked upon as a by-product of the Gas Industry, with little value. It was given a bad name partly because little care was taken in its preparation and marketing, and partly because the plentiful supply of good quality house coal was adequate to meet consumer demands. Industrialists, however, were quick to realize the value of this source of cheap fuel, and coke became predominantly an industrial and commercial fuel. With the development of carbonization some firms recognized the value of suitable solid smokeless fuels for the domestic market, and the Gas Companies and various low temperature carbonization concerns set out to produce fuels which would give satisfaction in this market. It was quickly found that it would help to overcome public prejudice if the fuels were given specific names instead of 'coke'. Then came the second World War and all schemes were put into cold storage, as it were. For some years after the war the demand for solid fuel of all types exceeded the supply and it was not until the passing of the Clean Air Act that the activities of coke producers was again concentrated on selecting the right type of smokeless fuel for the domestic market and giving it a name which implied a standard of quality.

During recent years some critics have complained that the standards adopted have not been sufficiently high to safeguard the consumer. The vexed question of moisture content has been raised frequently in Parliament, in the press and at conferences. Much work has been done on the problem, and producers and distributors are co-operating in an effort to minimize consumer complaints. Those distributors who are members of the Approved Coal Merchants' Scheme and/or the Authorised Coke Distributors' Scheme are required to examine complaints and give redress when these are justified. Nevertheless from time to time disagreement arises between buyer and seller and cases are brought before a Magistrates Court for settlement. Whilst there has been a tendency in recent years to bring such cases under the Merchandise Marks Act, it is interesting to note that the Weights and Measures Act of 1963 in Paragraph 6 of Part I of Schedule 6 reads:—

> "Any person who *with intent to defraud or deceive* damps any solid fuel shall be guilty of an offence."

This will not only safeguard the consumer but differentiate between the merchant who indulges in malpractices and the honest merchant.

(13) Finance

No survey of the problems of solid fuel distribution would be complete without reference to finance. Not only has the cost of fuel risen considerably over the last few years, requiring more capital to run a business of fuel distribution but the changing pattern of social life and of methods of distribution have all added an extra financial burden on the distributor. Take, for example, railway charges. Lighter fuels such as coke are now having to face a higher rate of carriage charge, because the railways say that the tonnage carried per train-load is less than that of the heavier fuels. This has been emphasized by the railways decision to impose a minimum charge of 7 tons irrespective of whether the actual tonnage contained in the wagon load is less than 7 tons; and a minimum charge based on a journey of 20 miles irrespective of the distance up to 20 miles. The necessity for a quick turn-round of railway wagons has resulted in the imposition of very high demurrage charges, and if a distributor falls behind in his clearance of wagons, due to labour or other difficulties, his costs are considerably increased. The Concentration Schemes do enable distributors to avoid such demurrage charges, and where merchants draw only from a Concentration Depot they are not faced with the rent and rates of their own depot.

It may not be generally known that the solid fuel distributive trade does not cost on a fixed percentage basis like most retail distributive trades. During the period of control prices were strictly regulated on a tonnage basis, and any increase in costs was applied equally over all domestic tonnage irrespective of the price of the fuel. This method of costing has continued in general, and with the increasing demand for the higher priced fuels the ratio of return per ton sold has tended to drop. Naturally, therefore, the trade has tended to become concentrated in fewer hands so that savings in efficiency can be offset against the higher costs.

(14) Future

Despite the problems which I have outlined, I believe that there is a future for solid smokeless fuel and granted goodwill on all sides, the ‘living fire’ will continue to be the embodiment of cheer in the average British home. It is possible that this may become a prestige symbol such as it is in America and that the open-fire will be supplementary to central heating. It must not be forgotten that solid smokeless fuel is derived from our own indigenous sources and that its use will help to make us less dependent on imports, so when local authorities are making forward plans for housing development I hope that this will be kept well in mind.

Discussion Opening by Sir John Charrington

THE outstanding impression I got in reading the papers by Mr. Richards, Mr. Batey and Mr. Allen was the remarkably sympathetic and patient firmness with which they and their local authorities have pressed on with clean air. You can read all through their papers the difficulties they were up against and I was very much struck with the patient methods they adopted. On reading Mr. Richards’ paper I could not help a feeling of some shame at the tricks which were played by some members of my trade in Manchester in the early days to try and hold up clean air. One must sympathize especially, I think, with these gentlemen, particularly perhaps with Mr. Batey in Sheffield, in the difficulty which I feel they must have in persuading householders to become enthusiastic about clean air when there is still inevitably a certain amount of smoke emission from industrial premises, and in my experience nothing will make the whole thing easier to get on with amongst householders if all industrial smoke is eliminated.

Mr. Richards is uneasy about the justification of the high prices of most smokeless fuels. I can fully understand and appreciate his feelings. I’m a distributor of coal and coke and I do not like these high prices any more than anybody else. The higher prices go, the more they tend to limit the turnover in my business, and I am prepared to say this—I can speak for the south of England at any rate and I very much doubt if in the north it is different—if there were to be another public inquiry as we had about ten years ago, we in the distributive trade have nothing whatever to fear in the charges we have to make for the distribution of smokeless solid fuel. It is a more costly job than distributing coal; I am not going to attempt to go into the details, and equally I am perfectly certain that the private producers like Coalite and Rexco, as well as the National Coal Board, are only too eager to keep the cost of their fuels down just as low as they can. It is regrettable but I do not think there is any cause for uneasiness.

Mr. Richards mentions the doubt about the right choice of appliance for burning smokeless solid fuel. This is a nice point: should people be encouraged to go on with any ordinary fireplace and burn the popular reactive smokeless solid fuels, which are rather expensive, or should they be encouraged to install one of the modern glass-fronted room heaters or an under-floor draught fire which consume fuel with far higher thermal efficiency and also consume considerably cheaper forms of coke? I can perfectly well understand that a local authority who has to foot part of the bill must prefer to see householders going for the type of fuel which does not call for the replacement of their grate with an expensive appliance. But I think that if I had to make a choice myself, I should go for a modern room heater, costly though it may be, because of the extremely high efficiency with which it operates and the adequate supplies of fuel which are available for use in them. Mr. Richards also alludes to the low heating standards in this country. This has been well known for many years and the more we relied solely on the central fireplace the worse it was. We all know of people standing with their back to the fire while the rest of the room is cold, but we must not overlook the fact of the very great increase in central heating which has taken place in the last few years and is continuing, and it is well to remember that apart from the back boiler to a bituminous coal fire, all other forms of central heating are smokeless. Anthracite, gas, electricity, coke, oil; they can all be relied upon to be smokeless in operation, and there is no doubt at all that as central heating spreads so the reliance upon the open fire is becoming less. This is a point worth bearing in mind when considering the confidence with which one can face the future for the supplies of open fire fuel.

Mr. Allen presses for all the fuel burning appliances in a house to be capable of burning smokeless fuel. I feel there is some confusion here. Admittedly, hard coke like Sunbrite needs a closable room heater or an underfeed-draught fire, and admittedly gas coke needs an improved open fire, but the reactive open fire fuels which are becoming increasingly popular: Coalite, Cleanglow, Rexco, Phimax, and the two new Coal Board fuels, Homefire and Roomheat, will all burn as freely upon an ordinary open fireplace as will house coal. And it is on these fuels I think we are likely to depend more and more in the smoke control areas in the future.

Mr. Otty and Mr. Bourne deal with the physical job of handling and distributing solid fuel. Mr. Otty deals very largely with the plans for concentration depots, and I would like to pay tribute to the National Coal Board for the part they have played in making these costly mechanized plants possible where the merchants individually were too small to create them for their own. It so happens––I say this with some pride––that my own company were the pioneers in the erection of these big concentration mechanized depots. Before ever Dr. Beeching had left I.C.I. and gone to British Railways, we had completed our first one near the Alexandra Palace in London; we shut down eight other depots and were able to put I think about 75,000 tons a year through that plant. But the point that I want to stress is this: our objective in spending a lot of money on that depot was not to make more money, but was so to improve the conditions under which labour operated so that we could employ a better type of man to go to our customers' houses. We were getting really in despair about the type of men we could get to do this unpleasant job of shovelling coal out of the side of a truck in all weathers. By the time they were loading, always under cover, with most of the hard work taken away, and with warm shower baths and a canteen, our whole position was changed, and we found ourselves recruiting a very different type of man indeed. I will be frank with you and admit that mercifully those depots have turned out to be economical too. We built two more and we are able to put, of my own company's tonnage, about, I suppose, a quarter of a million tons a year through those three depots. Now if a merchant is unable to do that, with British Railways closing the small yards, it really was a fine action of the Coal Board to come along, foot the bill and create these depots for the trade as a whole. They have helped, I believe, the householders, they have ertainly helped the traders, they have ertainly helped British Railways, and I ope that the Coal Board have helped hemselves too.

There is a point I want to make about he cost. Mr. Otty was confident that hese concentration depots will not lead o higher prices. I have been through egotiations with the Railways and I know ow difficult it is. We, as traders, spend a ot of money to create the depots, and by orking our traffic in train loads we expect fairly considerable reduction in rail harge. If we do not get that, the whole hing becomes completely uneconomic. Now unless the Coal Board are in future ble to strike really satisfactory bargains ith the Railways, and I do not feel quite s confident as Mr. Otty does, we may ee that as a result of helping the Railways ut of their difficulties by enabling them to lose yards, householders in some places re going to pay even more money, and hat I should regard as a very deplorable tate of affairs.

Mr. Bourne and I work very closely ogether. He is the General Manager of ny Association and he has very naturally vritten much the same sort of thoughts hat are in my own mind, and I have no riticisms or comments to make on his xcellent paper whatsoever. But I want to inish on this note. I do want to endorse vhat the Parliamentary Secretary to the Ministry of Power said this morning, that rovided householders are given the choice etween the various kinds of solid smokeess fuel, I am perfectly satisfied that there re adequate supplies of solid smokeless uels of one sort and another to enable us o go ahead with clean air as fast as the ocal authorities can manage it.

Discussion

R. A. Newton (London Borough of Lambeth) drew attention to the "ridiculously low" rate of 5 per cent establishment charge permissible where local authorities sought to do works of fireplace conversion in default of owners under Sect. 12 (2) of the Act. He also deplored the unnecessarily high prices quoted for appliances in the Minister's new Circular 51/65. The ratepayer, he said, was paying "through the nose". On enforcement of Smoke Control Orders, Smoke Inspectors ought to have the inclination and had to make the time to catch defaulters. If contravention went unchecked, the law was flouted and the Clean Air Act would become as ineffectual as the Litter Act.

Again on the question of cost, Mr. Newton regarded as hopelessly impracticable the President's reference to smoke control areas of five square miles.

Dr. W. R. Martine (British Medical Association) said that Mr. Allen had put up some very good points. The installation of appliances that had not been approved should be prohibited by law. A model byelaw was not enough, although Birmingham had got round that in part by making all new development of twenty houses or more, either municipal or private, smoke controlled from scratch. He thanked Mr. Allen for drawing attention to the penalty of higher rating for any householder who, at his own expense, made his house smokeless by installing central heating. He was very glad, moreover, to hear another plea for the individual who made his home smokeless while not in a proposed smoke control area and was, for that reason ineligible for grant. This had been put up by our Society more than once, but the Ministry, prompted, no doubt, by the Treasury, had said "no", but giving as their reason the difficulty facing a local authority in supervision of isolated premises located outside control areas. Was it not worthwhile considering the issue of a certificate of installation in such cases—the certificate to be cached until the house in question could be included in a proposed control area, and then cashed? The only extra work would be the maintenance of a register of such dwellings and an inspection to ensure that the dwelling had not changed hands when "smoke control" became imminent.

R. A. Pullen (The Park Gate Iron and Steel Company Limited) referred to the average Scunthorpe figures reported on page 43, and in particular to the sulphur dioxide levels, and asked what inference could be drawn from the recorded values in the industrial station 'B' for the middle quarters of 1964. Could one say that the contamination from space heating units was now as great as that from continuous industrial processes? The question was framed because of some of the remarks that appeared in Mr. Allen's paper, where the levels at Santon, adjacent to a steel works for 1938 were quoted, and in Mr. Batey's where reference was made to the problems that faced the steel industry. However, Mr. Pullen felt that only scant acknowledgement had been made to the recent major and very costly innovations that had been introduced and had contributed in such a large measure to the improved conditions being reported at Sheffield and Scunthorpe. Mr. Allen's text made it quite clear that houses had been pulled down in the Santon area, but nevertheless some current figures, taken out of interest, would show the reduction directly attributable to the efforts of the steel industry. Were these figures available?

H. E. T. Lowbridge (Willenhall) said he was prompted to speak as Secretary of the Midlands Joint Advisory Clean Air Council, since that body felt that there was an urgent need for a revision of the grant arrangements. Under Section 13 of the Clean Air Act, 40 per cent of the cost of adaptations was met by the Government, 30 per cent by local authorities and 30 per cent by owners or occupiers.

The present grant from the Government was a definite barrier to progress; local authorities in many industrial areas had by the nature of things, heavier commitments (such as slum clearance) than more fortunately placed authorities.

The Midlands Joint Advisory Clean Air Council felt that if the whole country was going to benefit from smoke control, the financial burden should be spread more evenly. No precedent would be created by spreading the burden over white as well as black areas—that was already happening in other directions, the cost of education, for instance, was contributed to by everybody.

He understood the Ministry of Housing and Local Government was spending £4,000,000 annually on grants for smoke control—this was an insignificant amount compared with the hundreds of millions of pounds paid out for the National Health Service. Surely if air pollution was injurious to health, and we were satisfied that it was, then the Government could very well afford to increase its grant and expedite the work of smoke control.

There was, he thought, a very good case for the payment of smoke control grants by taxation rather than by rates.

K. H. Marsden (Watford) referred to the policy of the Ministry regarding payment of grants to householders who installed central heating. The Watford Borough Council had decided to base the grant on £25 for each coal-burning appliance that was replaced, but this was not acceptable to the Ministry for exchequer contribution in accordance with their recent circular. The complicated procedure now laid down meant that experienced inspectors had to be sent to houses solely to estimate what the hypothetical cost would be if the householders installed separate appliances in each room in regular use instead of the system they would actually be installing. This costing for appliances which would never be fitted was, he declared, a complete waste of manpower.

P. Draper (Individual Member) thought Mr. Batey's paper commendably brief. It was most gratifying that, over the past eight years, the Sheffield smoke meters had shown a reduction of nearly 50 per cent; but he suggested it would be informative if the author could give some indication whether this was by securing better combustion or by changing to smokeless fuels.

He considered the fact that the sulphur meters showed a reduction, over the same period, of about 25 per cent, was significant. Unlike smoke, sulphur emission per unit of fuel could not be reduced by achieving better combustion; thus ground level pollution could be reduced only by burning less fuel, using fuels of lower sulphur content or by better dispersal of the flue gases through high chimneys.

Mr. Draper concluded that it would enhance the value of his paper if Mr. Batey could state what factors were responsible for the improvements at Sheffield.

S. A. Eade (Harlow) referred to the delay in the confirmation of a Smoke Control Order which could be caused by objections on insubstantial grounds by people who were not prepared to follow their objections through to the Inquiry. There appeared to be an example of this in Mr. Richard's paper.

The Clean Air Act required the Minister to hold an Inquiry where an objection was made and not withdrawn, but valid grounds for objection were not specified and a person was not required to demonstrate in any way that he was a serious objector.

In Harlow, which Mr. Eade said would be the first New Town to complete its smoke control programme, confirmation of the final Order was delayed by two old people who had made written objections but refused an invitation to attend a public Inquiry. The Minister dealt with the matter by written representation in which the objectors took no part. Their resentment to the Order had apparently been satisfied by their letter to the Minister who had been obliged to go through a time-consuming procedure to demonstrate that justice had been done.

Although he would not suggest removing the right of a person to object on reasonable grounds that would be supported at an Inquiry, Mr. Eade thought the point had surely been reached in smoke control, where objections based on the harmlessness of smoke, the uselessness of smoke control areas and perhaps even the price of fuel should be declared invalid.

He asked for Mr. Richard's views.

C. H. Crawford (Brierley Hill) said that the Pensnett Concentration Depot was a Brierley Hill enterprise—another success story for a steel town.

He advised delegates to accept these Depots into their districts as the huge stocks of solid smokeless fuel on view helped to refute suggestions of shortages raised when Smoke Control Orders were under consideration. He went on, however, to warn the trade that quality control was essential and complaints of excessive slack in delivered coke would not help sales. Nor would fuel containing pieces which caused "spitting" when the fire was refuelled.

Mr. Crawford also criticized the West Midland Gas Board for what he thought were excessive increases in the charges for fitting gas fires and pokers.

Authors' Replies

Mr. Richards, replying to Mr. Eade, said there has been no organized opposition to smoke control in Manchester since 1960, when there were 420 objectors to the first large smoke control order at Wythenshawe. A Public Inquiry was held but none of the objectors appeared.

There were two objectors to one of the fifteen smoke control orders made since then, but after discussion with representatives of the Health Department the objections were withdrawn, and no other Public Inquiry had been necessary. Accordingly, so far as Manchester's experience went, there appeared to be no need for acceptable grounds of objection to be defined.

Mr. Bourne said he was glad to hear Mr. Crawford's comments about the Pensnett Concentration Depot at Brierley Hill and would ask the Local Authority representatives present to give planning permission for such Depots when this was applied for. With the closure of Railway lines and Depots in many areas new road depots would have to be provided if consumers were to continue to obtain solid fuel. Permission for some new depots was refused and this meant that Merchants had to go long distances in order to maintain a service to their customers.

Every effort would be made to ensure that the coke delivered was completely suitable. Unfortunately it was not easy when bagging coke at Gas Works or at a Merchant's Depot to detect the shale which caused the spitting. Gas Boards were taking steps to avoid this type of complaint by selecting coals for carbonization which were free from shale. Under the Authorized Coke Distributors' Scheme and the Approved Coal Merchants' Scheme merchants were required to give consumer satisfaction and those firms who belonged to these schemes endeavoured to do so.

Mr. Otty said that progress on establishing mechanized depots would be seriously hampered if the Railways were not prepared to make reasonable contributions out of their savings. Each scheme involved individual negotiations and if Railway movement proved financially unattractive other means of transport were considered. One of the most important principles which had been established when the tripartite machinery was set up was that no concentration should be proceeded with, which would result in the cost of domestic fuel to consumers being raised on average over the area affected.

A RECENT SURVEY'S FINDINGS CONCERNING AIR POLLUTION AND MORTALITY FROM LUNG CANCER AND BRONCHITIS

by

*A. J. Wicken**

ABSTRACT

The paper is based upon the report of a recent survey concerning the environmental factors associated with lung cancer and bronchitis mortality in several local authority areas in North East England. The results of the survey are briefly outlined with particular reference to the associations which lung cancer and bronchitis mortality were found to have with area of residence and air pollution.

Differences in lung cancer and bronchitis mortality rates were found between urban and rural areas and localities of different environmental character within a particular local authority area. These differences did not result from variation in the age, smoking habit or social class composition of the various areas and localities. They were, however, accompanied by differences in the level of air pollution, which indicates that both lung cancer and bronchitis mortality are associated with air pollution.

The paper concludes with a discussion of the value of carrying out investi-vestigations of this kind in particular local authority areas.

Introduction

An investigation has recently been carried out in North East England concerning environmental factors associated with lung cancer and bronchitis mortality. The full report of this investigation, copies of which are available on request, has been published elsewhere.† Both lung cancer and bronchitis mortality were found to be associated with area of residence and smoking habits. Bronchitis mortality was found to be associated with social class, and lung cancer mortality with previous illness from bronchitis. Evidence was obtained that areas in which the lung cancer and bronchitis mortality rates were relatively high were also subject to higher levels of air pollution.

The purpose of this paper is to illustrate the application of surveys of this kind to public health problems. It first describes the evidence obtained in the survey concerning air pollution and mortality from lung cancer and bronchitis, and proceeds to discuss the uses to which this kind of information can be put.

The survey method

The survey was carried out during 1963 by the Health Surveys Unit of AGB Research Limited at the request of the Health Committee of the Urban District Council of Eston. The cost of the investigation was met by the Tobacco Research Council.

The purpose of the survey was to study the main factors likely to be associated with lung cancer and bronchitis mortality. The factors selected for study were age, area of residence, air pollution, smoking habits, social class and previous respiratory illness. In order to obtain information relevant to the study of the area of residence and air pollution factors, the survey was carried out in Eston U.D., Stockton-on-Tees M.B. and a group of Rural Districts, Croft, Northallerton, Richmond and Stokesley.

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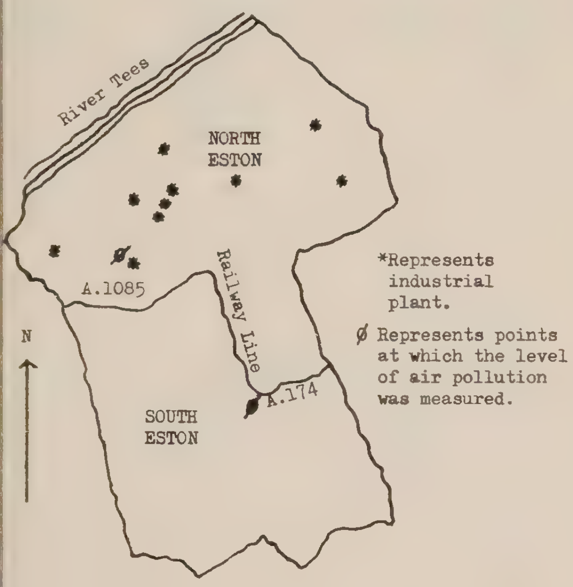
* Head of Health Surveys, AGB Research Limited.

† Report on a Study of Environmental Factors associated with Lung Cancer and Bronchitis Mortality in Areas of North East England. Tobacco Research Council Research Paper No. 8: A. J. Wicken and S. F. Buck. Copies are available on request to the Council at Glen House, Stag Place, London, S.W.1. (Phone: TATe Gallery 2041.)

MAP OF ESTON U.D.


River Tees
NORTH ESTON
A.1085
Railway Line
A.174
SOUTH ESTON
N
*Represents industrial plant.
ø Represents points at which the level of air pollution was measured.

The study was based primarily on three sources of information. The first was a survey of people who had died from lung cancer or bronchitis during the years 1952–62 and of a sample of people who had died from causes other than respiratory illness during the same period. Those who had died from non-respiratory causes were matched by sex and age to the group of people who had died of lung cancer and bronchitis. Information about all these decedents was obtained by personal interview with their relatives. Comparison of the information obtained for each group indicated factors associated with lung cancer and bronchitis mortality. The second source of information was a sample survey of the living population. The purpose of this was to obtain estimates of the numbers of living people in the various age, smoking habit, social class and other sub-groups in the areas studied. With this information, and the information obtained from the survey of people who had died of lung cancer or bronchitis, it was possible to calculate mortality rates for various sub-groups of the population. The third source of information consisted of specially made measurements of smoke and sulphur dioxide concentrations in the atmosphere at three sites in Eston U.D.

Interviews were obtained with the relatives of 2,386 decedents, 87 per cent of those selected for study. Interviews were also carried out in 4,167 households, 96 per cent of those selected for study, and yielded information about 9,256 of the living population.

Lung cancer and bronchitis mortality rates in Eston U.D., Stockton-on-Tees M.B. and the four rural districts

Eston U.D. and Stockton-on-Tees M.B. are both industrial areas and thus differ from the Rural Districts of Croft, Northallerton, Richmond and Stokesley. One of the differences between the two urban areas and the group of rural areas, the degree of air pollution, is obvious from common observation. Although no air pollution measurements were made in Stockton and the group of rural areas, the finding of higher lung cancer and bronchitis mortality rates in Eston and Stockton than in the four rural districts would create the presumption of an association of air pollution with lung cancer and bronchitis mortality.

The lung cancer and bronchitis mortality rates of Eston, Stockton and the four rural districts are shown in Table 1. It will be seen that the rates for both causes of death in men and women tended to be greater in Stockton and Eston than in the rural districts, the differences between Stockton and Eston being relatively small.

The age structure of the population of the three areas was closely similar, but tobacco consumption in the rural districts was lower. The three areas also differed in their social class composition, the average social class being highest in the rural districts and

TABLE 1

Lung cancer and bronchitis mortality rates per 100,000 per year among individuals aged 35 years or more in Eston, Stockton and four rural districts, 1952-62

	Rural districts	*Stockton M.B.*	*Eston U.D.*
Lung cancer:			
Men	69	147	151
Women	8	24	15
Bronchitis:			
Men	69	155	194
Women	34	58	79

TABLE 2

Actual and standardised lung cancer and bronchitis mortality rates per 100,000 per year among men aged 35 years or more in Eston, Stockton and four rural districts, 1952-62

		Standardized for:	
	Actual	*Age and smoking habits*	*Social class*
Rural districts	69	65	79
Stockton-on-Tees M.B.	147	146	148
Eston U.D.	151	151	151

lowest in Eston. Since lung cancer and bronchitis mortality are associated with smoking habits and bronchitis mortality with social class, it was possible that the differences in the lung cancer and bronchitis mortality rates in the three areas had resulted from the differences in the smoking habits and social class composition of their populations. In order to test whether this had occurred, the mortality rates were standardized, first to show what the mortality rate would have been if the age-within-smoking-habit distribution had been the same as in Eston, and the second to show what it would have been if the social class distribution had been the same as in Eston. The actual and standardized lung cancer mortality rates for men are shown in Table 2.

The standardized mortality rates were almost the same as the actual rates, from which it follows that the difference in mortality rates for the two urban areas on the one hand and the group of rural areas on the other did not result from differences in the age, social class and smoking habit composition of the population. Some other factor, or factors, are therefore required to explain the differences, and a possible factor is air pollution.

Differences in lung cancer and bronchitis mortality between urban and rural areas have been found in other studies. An unusual feature of this investigation, however, was the provision it made for comparing lung cancer and bronchitis mortality in different parts of a particular urban area. The results of such a comparison are described in the next section.

Comparison of the mortality rates in two localities within Eston Urban District

The people who were studied in Eston, both those who died of lung cancer or bronchitis or from non-respiratory causes and those in the sample of the living population, were of course drawn from various parts of the urban district. In order to study differences in the lung cancer and bronchitis mortality rates within Eston its total area was divided into two localities, North and South. Approximately two-thirds of the population live in North Eston, which contains extensive heavy industry; one-third live in South Eston which is a residential area extending towards open country. These two localities are shown in the map.

Comparison of the people who had died of lung cancer or bronchitis (i.e. the subjects) in Eston Urban District during the period 1952/62 with those whose death resulted from non-respiratory causes (i.e. the controls), reveals a tendency for people who died of lung cancer or bronchitis to have last resided in North Eston. This is illustrated for men in Table 3.

This shows that mortality from lung cancer and bronchitis within Eston U.D. was associated with locality of residence. Calculation of the lung cancer and bronchitis mortality rates for the two localities shows that men in North Eston were 1½–2½ times more likely to die of lung cancer or bronchitis if they lived in North Eston than if they lived in South Eston. Table 4 presents the details of these mortality rates.

Compared with the inhabitants of South Eston, people who lived in North Eston were on average slightly older, more inclined to smoke, and were on average of lower social class. Since lung cancer and bronchitis mortality rates are associated with age, smoking habits and social class, higher lung cancer mortality rates were to be expected in North Eston than in South Eston. The differences found, however, were greater than those which could have been expected. For example, if allowance were made for the differences in age, smoking habits and social class, the lung cancer mortality rate would be expected to be 30 per cent higher in North Eston than in South Eston, whereas it was in fact about 75 per cent higher. Some factor or factors, other than age, smoking habits and social class are consequently required to explain the higher lung cancer and bronchitis mortality rates found in North Eston.

Measurements of air pollution were made during the period May 1963 to April 1964. Weekly observations were made of smoke and sulphur dioxide concentrations at three sites, two in North Eston and one in South Eston. The mean weekly readings are shown in Table 5.

TABLE 3

Locality of last residence of male lung cancer and bronchitis subjects and controls in Eston U.D.

	Male Lung Cancer		*Male Bronchitis*	
	Subjects	*Controls*	*Subjects*	*Controls*
Number in survey	119	119	158	158
Percentage who last lived in:				
North Eston	74	68	80	73
South Eston	26	32	20	27

TABLE 4

Lung cancer and bronchitis mortality rates per 100,000 per year among men aged 35 years or more in North and South Eston, 1952-1962

	South Eston	*North Eston*
Lung cancer	104	180
Bronchitis	101	251

TABLE 5

Smoke and sulphur dioxide concentrations in Eston U.D.: micrograms per cubic metre (1963-64)

	Average weekly reading May 1963 to April 1964:		
	Site (1) *(N. Eston)*	*Site (2)* *(N. Eston)*	*Site (3)* *(S. Eston)*
Smoke	168	152	80
Sulphur dioxide	119	110	74

TABLE 6

Mortality rates per 100,000 per year among men aged 35 years or more working in two levels of air pollution in Eston U.D. 1952-62 (standardized for locality of residence)

	Level of air pollution of employment:	
	Lung cancer	*Bronchitis*
Higher	242	285
Lower	119	160

TABLE 7

Lung cancer and bronchitis mortality rates per 100,000 per year among men aged 35 years or more, age-standardized to the combined population of Eston U.D., Stockton-on-Tees M.B. and the four rural districts (1952-62)

	Lung Cancer			*Bronchitis*		
	Eston U.D.	*Stockton M.B.*	*Rural Districts*	*Eston U.D.*	*Stockton M.B.*	*Rural Districts*
Non-smokers	20*	25*	29*	118	72	31*
Cigarettes only:						
1–10 a day	121	155	36*	138	203	81
11–22 a day	169	203	60	262	169	37*
23+ a day	661	418	267	492	263	77*
Mixed smokers	239*	159	104*	321	123	115
Pipe and/or cigars	148	66	54	255	119	61

* Indicates that the mortality rate was based on fewer than 10 deaths.

Both for smoke and sulphur dioxide the levels of air pollution at the sites in North Eston were considerably greater than the levels found at the site in South Eston. There is thus evidence that North Eston is subject to a generally higher level of air pollution than South Eston. Since the higher level of air pollution was found in the same locality as the higher lung cancer and bronchitis mortality rates an association between air pollution and the two causes of death is indicated.

Further evidence that air pollution is associated with lung cancer and bronchitis mortality was provided by information about the level of air pollution at places of work. Officials with local knowledge assessed the level of air pollution at the place of work of both the people who had died of lung cancer and bronchitis and of the sample of the living population. Occupations were classified into two groups, with a higher and lower level of air pollution: about one-quarter of the men aged 35 years or more in Eston have occupations falling into the group classified as having a higher level of air pollution. In calculating lung cancer and bronchitis mortality rates for men working in the two occupation groups, allowance was made for their place of residence in order to avoid the possibility that apparent differences between the two occupational groups might simply have reflected differences in the locality of residence. Table 6 shows the results of these calculations.

Relative strength of the associations of area and smoking habits with lung cancer and bronchitis mortality

Thus the survey's comparisons between administrative areas and between localities within one of these areas showed that lung cancer and bronchitis mortality rates were higher in districts with relatively high levels of air pollution than in those with relatively low air pollution. This indicates that air pollution is associated with lung cancer and bronchitis mortality.

The survey also showed that other factors, including smoking habits, were associated with lung cancer and bronchitis mortality. Table 7 shows the mortality rates for men aged 35 years or more in the three areas analysed by smoking habits, ex-

TABLE 8

Ratios of mortality rates of heavy cigarette smokers to those of moderate and light smokers of cigarettes only, and non-smokers (1952-62)

	Ratios of mortality rates of heavy smokers of cigarettes only in Eston U.D. to:		
	Eston U.D.	*Stockton M.B.*	*Rural Districts*
ung Cancer:			
Heavy smokers	1·0	1·6	2·5
Moderate smokers	3·9	3·3	11·0
Light smokers	5·5	4·3	18·4
Non-smokers	33·0	26·4	22·8
ronchitis:			
Heavy smokers	1·0	1·9	6·4
Moderate smokers	1·9	2·9	13·3
Light smokers	3·6	2·4	6·1
Non-smokers	4·2	6·8	15·9

mokers being classified according to heir previous smoking habits. These ortality rates have been standardized o the age distribution of the combined opulation of Eston, Stockton and the our rural districts in order to allow or differences in the age structure of he various groups.

In order to compare the strength of he associations of area and smoking abits with lung cancer and bronchitis ortality, one may examine the ratios f risks to which people in different reas and smoking habit groups are ubject. Table 8 which has been erived from Table 7 shows how many imes more likely to die of lung cancer r bronchitis are male heavy smokers n Eston than men in various other ub-groups of the population. For xample, the lung cancer mortality ate of male heavy smokers (23 or ore per day) of cigarettes only in ston was 5·5 times as great as that f light smokers (1–10 per day) of igarettes only in Eston, but it was nly 2·5 times as great as that for eavy smokers of cigarettes only in he four rural districts. On the other and, the bronchitis mortality rate mong heavy smokers of cigarettes nly in Eston was 3·6 times as great s that for light smokers of cigarettes nly in Eston but 6·4 times as great s that for heavy smokers of cigarettes nly in the four rural districts.

In general, this table shows that in so far as area was associated with air pollution lung cancer mortality was more strongly associated with smoking habits than with air pollution, but that bronchitis mortality was more strongly associated with air pollution than with smoking habits.

Although the comparison of mortality rates for extreme sub-groups gives an indication of the extent of the associations found, it does not take into account the numbers of people in each sub-group. This can be done by calculating the proportion of deaths which would have occurred if the mortality rates of the whole population had been the same as those found in the sub-groups subject to the least risk.

For example, only 48 per cent of the male lung cancer deaths in Eston U.D. would have occurred if, in each age group, all men had been subject to the lung cancer mortality rate found among men of the same age in the four rural areas. Table 9 gives further examples.

The value of investigations of this kind

Surveys of this kind obviously contribute to our general understanding of the importance of environmental factors in relation to human health. This particular survey has provided information which contributes to knowledge of the extent to which air pollution is associated

TABLE 9

Proportion of male deaths which would have occurred in Eston if the mortality rates of men in the least susceptible groups had applied to all men

	Proportion of deaths which would have occurred if all men had been subject to the mortality rates found among:	
	Men in the rural areas *Per cent*	*Male non-smokers* *Per cent*
Lung cancer	48	13
Bronchitis	30	61

with ill-health and the relative importance of this association in comparison with the associations which other factors have with these illnesses. Further work, however, remains to be done in measuring more precisely the association between air pollution and respiratory illness and in evaluating the associations of other factors, such as population density and damp housing, with these illnesses.

The survey described in this paper was not designed simply as a general study of the relationship between certain environmental factors and lung cancer and bronchitis. It was carried out at the request of a particular local government authority because of locally felt concern at the number of deaths which were due to lung cancer or bronchitis. It is therefore of interest to consider the uses to which the results from a survey of this kind can be put at a local level. These uses can be described in two groups, those relating to direct administrative action and those relating to the moulding of opinion.

The results of a local survey similar to that described in this paper, extended perhaps to cover illness and incapacity as well as deaths and taking into account information already available in local records, could be used to guide local administrative decisions. For example, if levels of air pollution and associated ill-health in different parts of a local administrative area were charted, the resulting information could be used in planning the distribution of industrial and residential building. It could be used in deciding priorities for redevelopment. It would be relevant to establishing priorities amongst applicants for Council tenancies. It might provide the basis for decisions about the minimum height of industrial chimneys. It could indicate areas which ought to be designated as smoke control areas under the Clean Air Act.

In addition to the use of survey results as the basis of direct action taken by the Local Authority itself, their publication might have valuable effects upon opinion. They could impress upon people concerned with the design and operation of industrial processes the importance of minimizing the degree of air pollution involved. They could support an authority's drive to persuade householders to use fuels less likely to pollute the air.

One aspect of the survey described in this paper is that it was carried out by an independent research organization. Such organizations have a useful part to play in projects of this kind since they are able to assist in the planning and design of the project, in collecting the information through trained interviewers, in analyzing the results by the appropriate statistical methods and in recording the findings in a suitable form. This work can be carried out under the direction of the Medical Officer of Health or of some suitably qualified external consultant. The cost need not be great in relation to other kinds of expenditure by local authorities: a project can be carried out at a cost equivalent to that of building only a few Council houses or of carrying out a minor road improvement scheme.

ODOUR CONTROL BY CATALYTIC COMBUSTION

by

*Erwin Betz, MS.CHE., BBA.**

ABSTRACT

This paper outlines generally the problems which have been dealt with satisfactorily by catalytic combustion, the economics of catalytic combustion and alternative methods for the removal of odorous effluents.

ume problems from Industrial remises

IF we examine the air pollution problem in general it can readily be seen that the problems can be plit into three basic groups, as ollows:

. Particulate matter such as smokes, soots and dusts.

. Inorganic gases, particularly sulphur dioxide.

. Organic material in the vapour and aerosol phase.

roup 1—Particulate Matter

Much has been published and much ractical experience has been gained the removal of solid particulate atter of all particle size. Many arying types of highly refined equipent such as bag filters, cyclones, lectrostatic precipitation, multi-wash ystems and normal filtration systems re available to solve virtually all roblems of this nature.

roup 2—Inorganic Gases

Here again a great deal has been ublished on the subject of sulphur ioxide which is the main offender in is group. At the moment the only al technical solution for large-scale ischarge of this gas appears to be the se of high chimneys and subsequent ispersion.

roup 3—Organic Material

In this group there are many varying types of organic chemicals comprising mainly carbon, hydrogen and nitrogens with occasionally some sulphur such as would be present in the mercaptans, thiophenes, etc. The problem is probably more widespread than is commonly realized, and could also be considered to be potentially more dangerous than either Group 1 or Group 2 when one considers the complex nature of many organic chemicals which are released daily to the atmosphere completely untreated throughout the industrial world.

Many of these hydrocarbons have been proved to be of a carcinogenic nature, and tests in America have proved a connection by exposing animals to hydrocarbon vapours with the subsequent formation of lung cancer.

Whilst legislation in the form of the "Clean Air Act" covers very well for the emission of smokes and dusts and the "Alkali Act" covers many of the inorganic and some of the organic effluents, many industrial effluents are not covered as yet by any real legislation, and it is left to the local authorities to attempt to enforce the production of clean and odour free air without any real empirical legislation to assist them.

It is interesting to note, however, that in the north Rhine-Westphalia District of Germany legislation is being introduced to prevent release of this nature in the industrial finishing field.

In its 4th reading the bill contained the following paragraphs:

Managing Director af KAVAG

Paragraph 1

1. This order applies to paint and varnish drying ovens which evaporate during operation more than 10 kg/hour or more than 200 kg/week of combustible materials.
2. If several paint and varnish drying ovens are operating in a particular area they are to be considered as one plant.

Paragraph 2

1. The paint and varnish drying ovens are only allowed to operate if the waste gases prior to emission to the atmosphere are purified by a catalytic or thermal oxidation method. The equipment for catalytic or thermal oxidation should be erected and operated in such a manner as to produce an undiluted waste gas containing not more than 100 mg of combustible material per normal cubic metre.
   Other methods for purification would be allowed if the above purity is obtained and with the proviso that the emitted materials shall not pollute the aqueous plant effluent.

Paragraph 3

3. Various authorities are specified to carry out tests on equipment installed to ensure continuity of satisfactory operation.

Generally speaking, however, it would appear that insufficient work has been carried out by responsible bodies to investigate the effect of these nuisances on the neighbourhood population and agriculture.

Group 3 comprises many effluents from many types of processes and some of these are outlined later in this paper. However, it is worth pointing out that some of the processes under discussion can release organic material at a rate as high as 6,000 tons of material per year. This is probably rather an extreme figure only obtained from very large plants, though many processes release several hundred tons of material per year.

Methods for the Removal of Organic Fume Nuisances

There are three general methods for removing organic fume nuisances. These are outlined below.

1. Water Wash

Water wash provides a relatively cheap investment cost method of handling this problem. The major trouble here is that the installation of a washer will rarely be successful. The system will often remove the condensed organic material which forms as the higher boiling fractions condense out in the form of aerosols, but will rarely be very effective at all with the low boiling point fractions. This system is normally between 40 and 60 per cent efficient when measurements are taken at the inlet and outlet of the washer or scrubber unit.

It is interesting here to examine Webber's law dealing with the relationship between the sensitivity of the human senses (sight, hearing, touch, taste, and smell) and the applied stimulus. Taste and smell are known as the "chemical senses" and the least sensitive. Webber's law can basically be defined for any of the five senses as follows:

The increase in stimulus necessary to give a just noticeable change of sensation is proportional to the original stimulus.

Thus, where Delta S is the increase in stimulus necessary to give a noticeable change and S is the original stimulus:

$$\frac{\text{Delta S}}{\text{S}} = \text{a constant}$$

which could be defined as a statement of Webber's Law.

For the sense of smell it is found that this constant is roughly 1·3, which means that at least a 30 per cent change in intensity of smell is required to give a just noticeable change in sensation. It is, therefore, quite obvious that by removing only 50 or 60 per cent of the smell the noticeable effect would not be quite so marked on the observer.

2. Odour Masking

The principle of odour masking has been known for thousands of years, nd the perfume industry is one of the ldest. Almost a hundred years ago a Flemish scientist named Zwaardenaker discovered the possibility of dour masking.

Odour masking occurs when two mells are mixed in such a way that hey cancel each other out, producing o smell at all, which is not to be onfused with the normal use of erfume, which initially was to counterct one smell by the application of a econd more powerful smell.

Some industrial concerns have eveloped a wide range of effective asking agents to counteract particlar types of industrial fume. The ystem is effective when only dilute oncentrations of the offending aterials are present in the exhaust o be treated, and is generally limited o this type of application as cost of e masking chemicals would become rohibitive in instances where high eights of offensive material are resent.

It can also be fairly said that where e rate of organic material released to e atmosphere is high, odour maskg is really no solution at all, as the ffending materials are still present in e atmosphere in which the neighouring people must work and live.

Combustion Methods

The fact that virtually all organic aterial can be burnt to carbon ioxide and water vapour, both cometely harmless chemically, means bviously that oxidation or combuson of the offending material will give very satisfactory technical answer to is problem.

Three basic types of combustion e available. These are:

(*a*) Flare Equipment
(*b*) Direct Incineration
(*c*) Catalytic Combustion

) *Flare Equipment*

Occasionally, as in some refinery f-gases, the exhaust gas is of a fficient thermal capacity to maintain mbustion similar to normal burng. In these instances it is only necessary to lead the gases to the top of a flare stack and ignite them with a pilot burner and perhaps add flame stabilizers and flame traps.

(*b*) *Direct Incineration*

Most effluents do not fall within the flammable range, and it is necessary to raise the temperature of the gases to the auto-ignition temperature which is normally in the 800–1000°C range. Thus, by raising the temperature of an off-gas stream in a combustion chamber to the auto-ignition temperature the organic material will be spontaneously oxidized to carbon dioxide and water vapour.

It is not always quite as simple as this, and great care has to be taken to ensure that the gases are in a turbulent condition, that all the gases achieve the correct temperature, and it is also essential to keep the gases at the temperature for a period of about 1 second. This fulfills the 3 T's required for combustion—Time, Temperature, and Turbulence.

A flow diagram of a typical incineration unit is shown in Fig. 1.

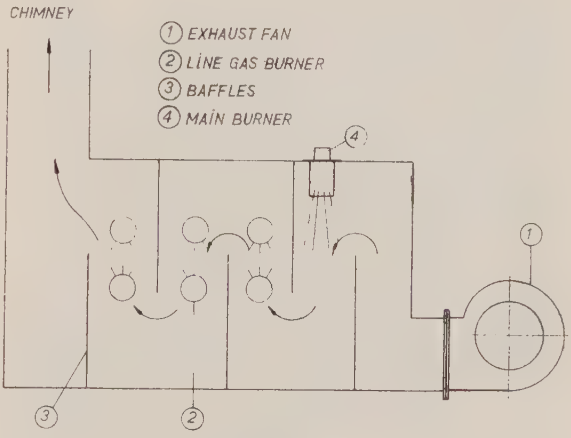


Fig. 1

Direct fired incineration has many uses, particularly when high dust loads are present which would cloak the commercially available catalyst described later, or where specific catalyst poisons are present which would obviate the use of catalysis.

Generally speaking, however, the operating requirements for this type of equipment are rather high, and a very high fuel input is required to raise the off-gas temperature to 800°C.

(c) Catalytic Combustion

For clarity's sake, we define again the function of a catalyst. A catalyst is a substance which will promote or alter the speed of a chemical reaction without itself being changed by the reaction. Catalytic combustion is simply, therefore, a means of altering the rate of reaction and lowering the temperature of reaction required for normal direct incineration.

It had been known for a long time that precious metals were harsh oxidation catalysts, and the late R. J. Ruff commenced work around 1945 to look for the correct catalyst formulation to give good oxidation properties in specific industrial off-gases. By 1949 a successful industrial catalyst was in production by the Catalytic Combustion Corporation in the United States which took the form of an element having the appearance of an all-metal air filter (see Fig. 2).

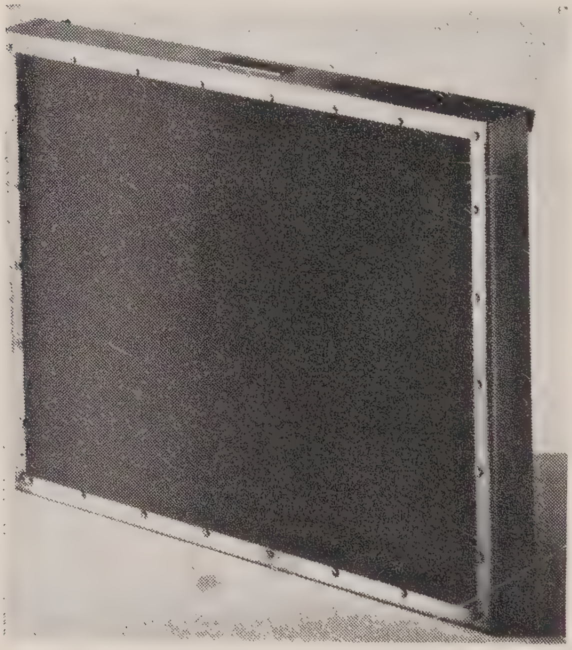


Fig. 2

Basically, the elements are formed by sewing together crimped, high nickel alloy ribbons into the form of mats and holding these mats between catalyzed retaining screens and mounting this into an alloy channel frame. The ribbon is coated with the active precious metal catalyst material and the various promoters used to ensure high activity and long life. Thus manufactured, the catalyst gives good mechanical and thermal stability which is highly important in most industrial equipment.

In practice the catalyst will give a light-off temperature between 250°C and 350°C, although occasionally a higher temperature might be required for some specific chemicals.

The catalyst formed in this way is exceptionally easy to handle and due to its construction it will not have many of the disadvantages of normal ceramic-type catalysts, such as channelling and abrasion. The element can also withstand temperatures up to 800°C and in special instances selected alloys can be used to withstand 1000°C. As in all chemical reactions, various basic design criteria must be studied.

Efficient catalytic combustion will be obtained when the correct space velocity is selected and where the correct operating temperature is used. It is, therefore, essential that when designing plants of this nature a sufficient volume of catalyst is provided and that the economical ignition temperature at the inlet of the catalyst is maintained.

The ignition temperature will vary from off-gas to off-gas, and would be selected for a particular application on experience or on actual field tests. The temperature can be anywhere between 240–450°C, although normally a temperature in the region of 320–350°C would be adequate.

If the temperature at which ignition just takes place is said to be t_z, a second point t_{ze} would be the economical catalytic reaction temperature at which optimum purification is obtained at an economical fuel input. Again, temperature t_{ze} depends upon the type of contaminant present in the off-gas, and Fig. 3 shows the temperatures at the catalyst for various gas mixtures a, b, and c. In some cases it is possible at relatively low temperatures to obtain purification efficiences of practically 100 per cent. However, some materials such as

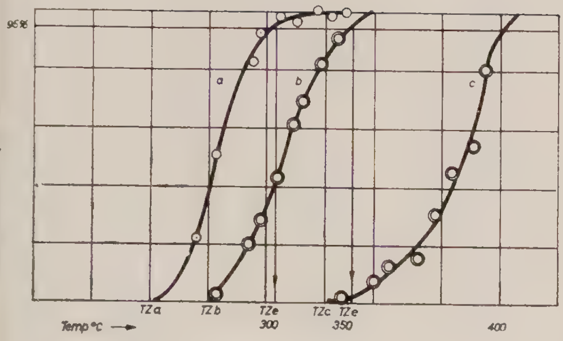


Fig. 3

formaldehyde or the phenols will demand technical solutions with an operating efficiency below 100 per cent, as the temperature at which 100 per cent oxidation can be achieved would be too high for good economics.

Thus, oxidation of phenol to about 95 per cent efficiency can be obtained at a certain temperature (about 320°C). The increase in temperature to obtain 98 per cent efficiency would be about 30°C, whereas to obtain 99·2 per cent efficiency the temperature before the catalyst would have to be increased by a further 130°C.

Catalytic Systems

Whilst the catalyst forms the heart of a system, it is obvious that care must be taken in the method in which the catalyst is used, and several basic types are available.

The most simple system is shown in Fig. 4. This is the push-through system, often used when the exhaust gases are already at the temperature very near to that required for catalytic combustion, or where the fume volume is very low and fuel costs not significant. This system would normally be complete with an exhaust fan as shown, which would both exhaust the fumes from the process and overcome the back pressure of the catalyst, which is normally on the order of $\frac{1}{2}''$ W.G. or less.

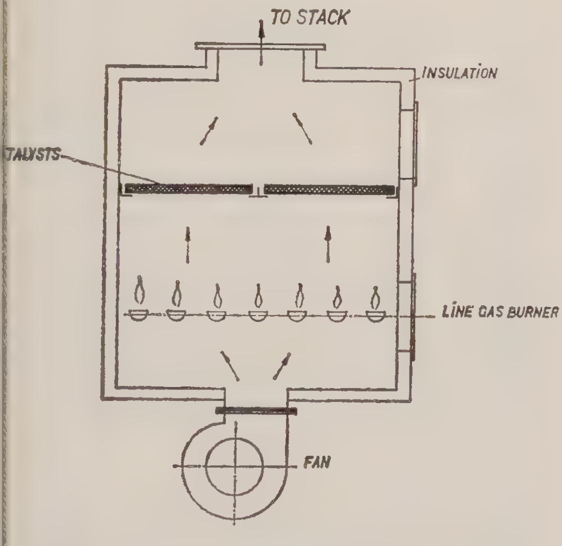


Fig. 4

Perhaps the most common system used is that shown in Fig. 5, which incorporates the heat exchanger. This system is called the SR or self-recuperative. In this system the fumes to be oxidized are drawn into the unit through the tubes of a heat exchanger and are then heated to final catalytic temperature by a burner directly into the off-gases. The hot gases then pass via the exhaust fan, which also serves as a mixing fan, to the catalyst. At the catalyst there will be a temperature rise in the fume proportional to the amount of organic material contained in the gases. The hot gases on the outlet of the catalyst then pass over the tubes of the heat exchanger and finally away to the stack.

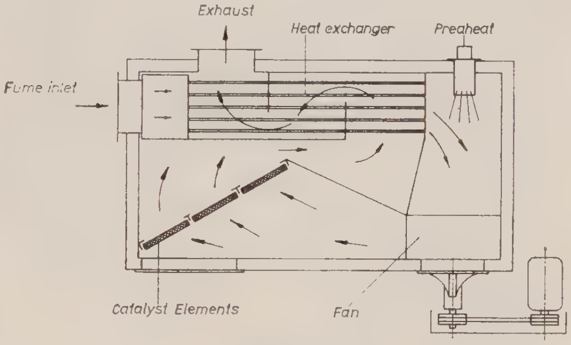


Fig. 5

These systems are normally designed so that even where the off-gas temperature is approximately ambient the burner will only be required to add heat sufficient to give a temperature rise of about 100°C to the off-gas. This will work out at a heating cost per 1000 scfm of about 1 shilling and 6 pence per hour.

If the above is compared with direct incineration methods, where a temperature rise of about 800°C is required and no heat exchange is possible due to difficulties of material construction, it can be seen that the operating cost for a direct incinerator would be about 12 shillings per 1000 scfm per hour.

Typical operating costs are shown in Table A, which compares the cost of direct incineration with that for catalytic combustion methods. It shows that even with the more expensive catalytic combustion installation costs the system is amply justified in a very short time.

It is also true to say that direct incineration equipment is fairly difficult to design due to the 3 factors referred to above required to give good operating results. The high temperatures involved in direct incineration equipment will also result in high running costs due to extra maintenance and repair work.

Actual Applications

We are listing below some of the actual problems which have been solved by our equipment, both here and throughout the rest of Europe.

Chemical Industry

Some of the most powerful and penetrating smells known to man are produced during the manufacture of certain chemicals. Many of these manufacturing processes involve the vapourizing of an organic material and the passing of this material at high temperatures to a catalyst bed where the desired product is produced. This product is then taken out of the gas stream either by condensation or water wash methods. However, condensation or water washing is never fully efficient, and various products will always pass forward in the exhaust gas from the system. Under this heading we have the manufacture of acetic acid, phthalic acid, cyclohexane, maleic acid, nitric acid and several others.

The off-gases from a phthalic anhydride plant contain various chemicals, including phthalic anhydride, maleic anhydride, naphthaquinone, cyclohexane and carbon monoxide. There will also be traces of other complex molecules, and generally the exhaust gas has a very pungent and irritating odour.

Catalytic combustion has now been applied to many such installations, and work is continuing to improve catalyst formulation for this off-gas. Catalyst life is normally about 20,000–25,000 operating hours in this type of process, following which the catalyst can be regenerated in the factory for about 30 per cent of the capital cost.

Acrylates and Amines

Some of the most highly pungent organic materials known in the chemical industry are such things as the amines and the acrylates. Acrylates have a very low odour threshold, reported to be as low as 35 p.p.m., and provide a very interesting application for catalytic combustion. The characteristic fishy odour of amines is also present at very low concentrations of amine in the atmosphere. Figures have shown, however[1], that satisfactory results can be obtained by means of catalytic combustion. It is interesting to note that in tests of the exhaust from catalytic systems, no amine smell can be detected in the off-gases, nor does any of the nitrogen present in the amine become converted to the oxides of nitrogen.

As stated, the acrylates are also highly pungent and installations are operating satisfactorily[2] where the fumes are collected from various sources around a manufacturing plant to a common catalytic system. Here trouble can be encountered where drums are emptied, where tankers unload, in vents from storage tanks, and in the main reactor vessels. Obviously all these smells are not generated at one time and normally several flexible collecting ducts are located around the factory, each with a shut-off plate and all connected to a single catalytic unit so that as the fumes occur they can be collected.

Nitric Acid Manufacture

The exhausts from a nitric acid plant have a characteristic brown colour, and the analysis of the exhaust would be approximately 3 per cent oxygen, with 2,000–3,000 p.p.m. of NO and NO_2, the rest being nitrogen and water vapour.

Catalytic combustion has provided an answer for this type of problem, though here the offensive gas is reduced rather than oxidized.

The actual system employed to eliminate the nitrous oxides will depend upon the particular nitric acid manufacturing process and also on the requirements of the local health inspectors (and in Great Britain, the Alkali Inspectorate).

Basically, the catalyst function will be that a sparge fuel such as methane, towns gas or refinery off-gas would be added to the tail gas stream ahead of the catalyst, and this mixture is then passed through the catalyst at the desired temperature. The oxygen in the gas stream reacts with the fuel as in normal catalytic combustion, and similarly the NO and NO_2 will also tend to oxidize the fuel and are reduced to nitrogen or the lower forms of the oxides. A typical flow diagram is shown in Fig. 6.

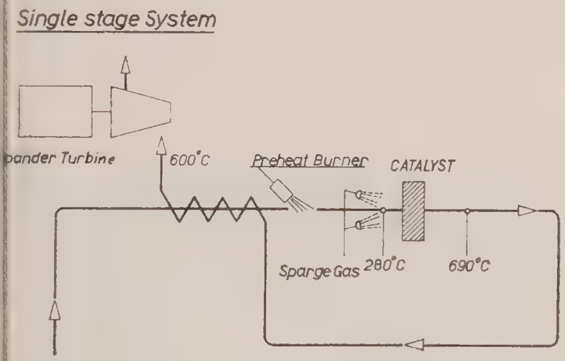


Fig. 6

In practice it is found that with a well-designed catalyst, in which sufficient fuel is added to remove about 0–80 per cent of the oxygen in the off-gas, the total oxides of nitrogen content will be reduced from about ,500 p.p.m. to about 500 p.p.m. All of the nitric oxide will be reduced, and there is some evidence that any nitrous oxide left in the exhaust will be in form of a complex, high molecular weight polymer of nitrous oxide.

While this is not a complete answer, the brown colour at the top of the stack will be completely removed, as there is little evidence of the nitrous oxide re-oxidizing close enough to the stack to form any colour.

The running cost of this type of plant is relatively cheap, in that the extra fuel can be recovered in the form of energy by hot gas turbines. In normal nitric acid plants some 30 per cent of the energy required to operate the plant is recovered in the turbine, whereas when using catalytic oxidation the recovery might be as high as 80–90 per cent. In this way the total operating cost of the nitric acid plant is not increased in such a way as to make the fume correction method uneconomical.

If a complete reduction of the oxides of nitrogen is required, then this is possible by using a 2-stage system, as shown in Fig. 7. In this system a second amount of sparge fuel is added after a first-stage catalyst operating as described above, and the gases are then cooled and passed to a second catalyst. Sufficient fuel is added so that the whole reaction will go to the reducing side, burning all the oxygen out of the tail gas. Utilizing this system, the total nitrogen oxide content would be less than 50 p.p.m. on the outlet of the second catalyst, although of course the system is more expensive, and accurate control of the second stage fuel addition adds complications.

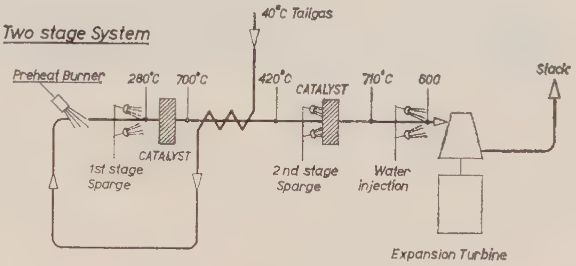


Fig. 7

Oven Industry

Some of the most interesting applications of the catalyst are in the metal finishing and paper treating industries, where paints or resins are applied in solution to the parts to be finished. In fact, it was with this industry in mind that R. J. Ruff first developed the catalyst. Generally the part to be finished will be painted either by flow coating, spraying, dipping, or roller coating, and is then passed through an oven suitable to the product. The purpose of the oven, of course, is to dry the paint rapidly and to cure the finish. All the solvents are dried from the paint by the heat in the oven, and these solvents form a considerable air pollution problem.

In some of the higher speed ovens of today, exhaust figures between 20 and 200 gallons of solvent per hour have been observed. Some of the solvents themselves are fairly expensive, and it would appear that a solvent recovery plant would be an economical proposition. It has, however, so far proved impracticable except in a few specialized cases where relatively pure solvents are used, to design suitable equipment.

With the use of catalytic combustion, however, it is possible to convert the heat of combustion of the solvents to useful heat to assist in the operation of the oven. Fig. 8 shows a typical installation where fumes are exhausted from an oven at about 350°F and heated to the required catalytic oxidation temperature of 600°F. A temperature rise occurs due to the solvent concentration in the exhaust gas, giving an outlet temperature from the catalyst of about 950°F. Fresh air is then heat exchanged with this hot exhaust gas and introduced to the oven. It can be seen that the exhaust gases are thus cooled again to approximately the same temperature that they are when exhausted from the oven in the first place. Therefore, the heat lost to the atmosphere remains identical to the case in which no catalytic incineration method is employed. A typical installation is shown in Fig. 9, which shows a catalytic unit mounted on a tin printing oven.

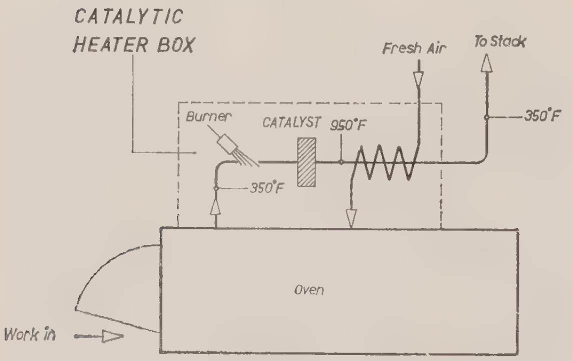


Fig. 8

It can be seen that the heat demand of the oven is made up of a combination of the heat of combustion of the solvents and the heat of combustion from the fuel used to raise the off-gas to the required catalytic temperature. Thus, all the heat of combustion of the solvents is used within the oven, and it is often found that the catalyst will be amortized within a short period of time, sometimes as quickly as 6 months. This heat saving is obtained simultaneously with the correction of air pollution in the neighbourhood. Many flow diagrams are available for this type of equipment. These have been described in the literature.[3-4-5]

Other Applications

The above gives a brief outline of the major uses which have been found for this particular catalyst. However, many other industries such as the manufacture of brake shoes, asphalt blowing, bacon smoking, core baking, shell moulding, coffee roasting, rice browning, all have problems which have been solved in practice by catalytic combustion systems.

In instances where details of the off-gas analyses are insufficient to design a catalytic unit, it is useful to carry out tests on site to determine the organic content of the off-gas and its catalytic ignition temperatures. For this purpose a special pilot model can be used to obtain all necessary data to proceed with main plant design. A photograph of one of these models is shown in Fig. 10. The unit is easily handled and will treat a flow of 70 scfm of the actual off-gas.

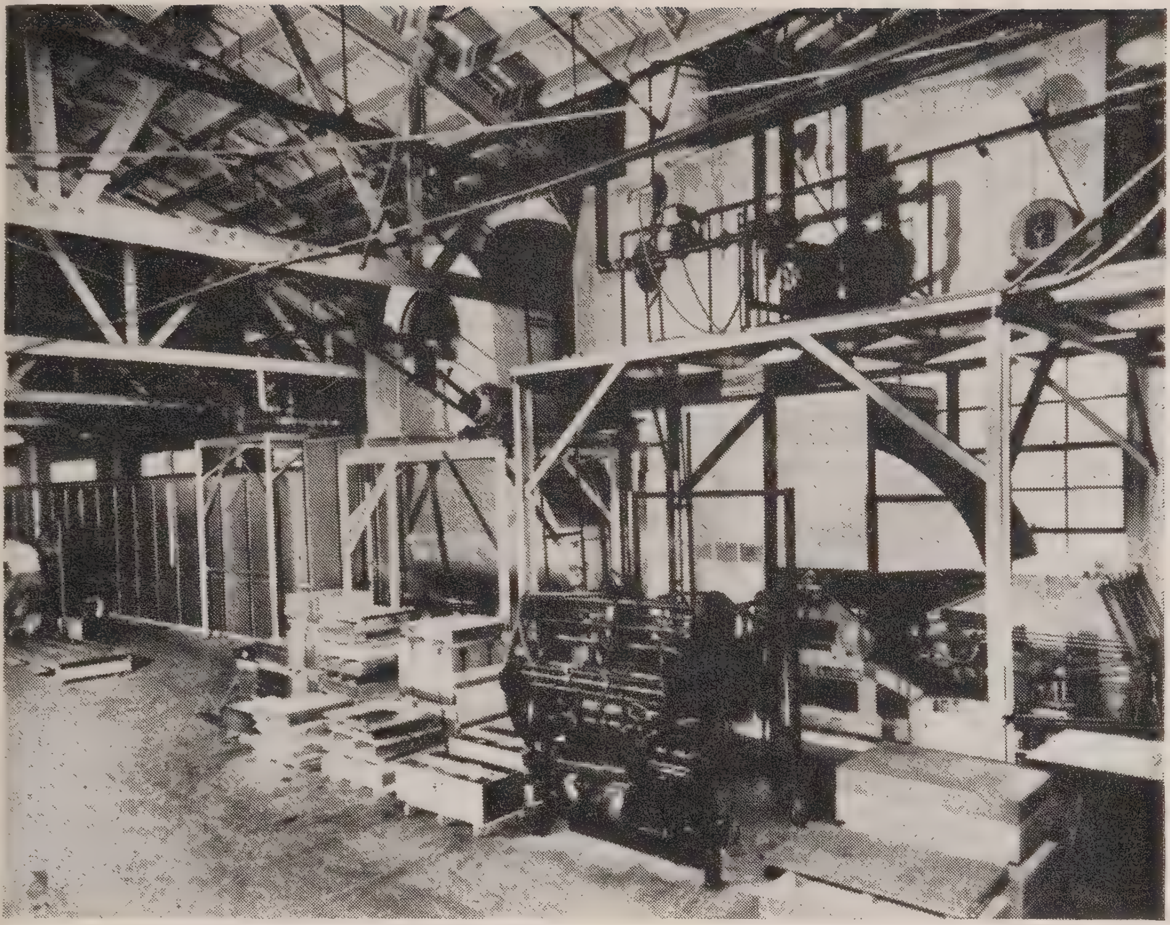


Fig. 9

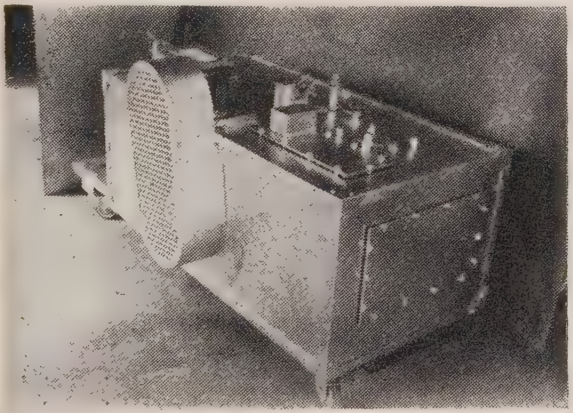


Fig. 10

Summary

We have shown the nature of the problems which can be solved by catalytic combustion methods, and also given an idea of the economics of the process. A summary has also been made of the alternative methods for correcting organic fumes together with a brief outline of the legislation covering the topic.

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Table A

Operating Costs for Odor Removal Plant

	Direct Incineration	*3-D2-SR Catalytic Unit w/ Heat Ex.*
(A) 24 *hr/day*—365 *day/yr*		
Volume of Fume	2,100 scfm	2,100 scfm
Temperature of incineration	1,300°F	650°F
Temperature at burner inlet	60°F	410°F
Temperature rise required by burner	1,240°F	250°F
Gallons fuel oil/hr	16·4	3·4
Fan HP	2	5
Capital Cost	£600	£4,300
Fuel Gas Oil at 1s./gal in £/annum	£7,200	£1,500
Electricity for fan in £/annum	60	170
Depreciation and capital charge at 10% £/annum	60	430
Catalyst regeneration in £/annum	nil	100
Total cost/annum 24 hr/day 7 day/wk	£7,320	£2,200
(B) 8 *hr/day*—5 *day/week*		
Cost of Fuel/annum, 1s./gal	£1,700	£356
Electricity for fan	15	43
Depreciation and capital charge	60	430
Catalyst regeneration	nil	100
Total Cost/annum 40 hr/wk	£1,775	£929

PREVENTION AND CONTROL OF POLLUTION FROM ROAD VEHICLES IN BELGIUM

by E. J. Coucke, M.B.E.[*]

ABSTRACT

After statistical information on Belgium (Inhabitants—road system—motor vehicles), the Belgian comprehensive scheme of vehicle inspection is described in some detail and also the function of the Belgian Fund for Study and Research on Road Safety.

Following chapters concern:

Diesel exhaust smoke from motor vehicles
(Instrument and method of measurement—Practical experiments in 1960 and 1961)
Pollution by exhaust gases from petrol engines (American, Belgian and French contributions to the solving of this problem)
Precautions against pollution in the vehicle inspection stations
Belgian legislation and regulations on air pollution in general and air pollution by motor vehicles.

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1. *Introduction.*
2. *Facts and figures concerning Belgium, the Belgians and their motor vehicles.*
3. *Technical inspection of motor vehicles in Belgium.*
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        - 5. 4. 2. Provisional regulations for the experimental period
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    - 6. 3. Belgian contribution
    - 6. 4. A French answer to the problem
7. *Precautions against air pollution in the Belgian vehicle inspection stations.*
    - 7. 1. General data and choice of a test-substance

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[*] Director, Fund for Study and Research on Road Safety, Brussels.

- 7. 2. Pollution levels and adoption of a pollution scale
- 7. 3. Mobile equipment used for measurements
- 7. 4. Results

8. *Present Belgian legislation and regulations on the subject of air pollution in general and air pollution by motor vehicles.*
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  - 8. 3. Resulting situation and provisions for the near future
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1. Introduction.

WHEN faced with the problem of prevention and control of pollution from road vehicles, the responsible Belgian authorities have tackled it with the help of existing organizations.

General conditions prevailing everywhere had to be taken into account, but also the particular Belgian background with its own physical, social, legal and administrative aspects.

That is why this paper begins with a description of Belgian conditions and organizations. It is necessary to have this information in order to see our reasons for acting in a certain way and to realize whether our methods are applicable in other circumstances of time and place.

2. Facts and Figures Concerning Belgium, the Belgians and their Motor Vehicles.

Here are a few facts and figures that concern Belgium and have a certain bearing upon the subject.

Speaking in round numbers, Belgium covers an area of 30,500 Km^2 or 11,800 square miles.

The population of the country, according to last year's statistics, numbers 9,400,000 inhabitants and 1,435,000 motor vehicles, 1,200,000 of these being motor-cars.

The Belgian road system, as far as I have been able to find out, consists of 11,500 km of principal roads and 43,000 km of secondary roads. In miles, the total is approximately 33,900 with about 7,100 of principal roads.

The corresponding average densities are:

308 inhabitants and 47 vehicles per km^2, or 797 inhabitants and 122 vehicles per sq. mile

26.3 vehicles per km of road, or 42.3 vehicles per mile.

In the central province of Brabant, which includes Belgium's capital city, Brussells, there are 2 million inhabitants and 300,000 motor-cars.

The annual increase in the motor vehicle population is at present about 10 per cent.

About 2.5 per cent of the motor-cars are diesel powered, the proportion being, of course, much higher for the heavy vehicles: about 25 per cent.

The motor vehicle population is very mixed in Belgium where, in the motor industry, we have no more manufacturers, but only assembly plants. Different origins appear in the following proportions, given here in round figures for 1964.

3. Technical Inspection of Motor Vehicles in Belgium.

3. 1. *Legal provisions.*

Technical inspection of motor vehicles, as it is organized and practised in Belgium today, is the outcome of an evolutionary process started about thirty years ago.

The present organization dates back to 1947, legal provisions of the time having been amended, as necessity arose, mainly in order to list new categories of vehicles to be inspected.

Origin	*Motor-cars*	*Other motor vehicles*	*Total*
Western Germany	500,000	90,000	590,000
France	340,000	50,000	390,000
United Kingdom	170,000	35,000	205,000
United States	70,000	35,000	105,000
Italy	70,000	5,000	75,000
Sweden	12,000	8,000	20,000
Netherlands	16,000	4,000	20,000
Czechoslovakia	14,000	500	15,000
Other countries	7,500	7,500	15,000
TOTAL	1,200,000	235,000	1,435,000

National origin of Belgian motor vehicles

The task of vehicle inspection is entrusted by the Government to ten private concerns, who were individually selected and approved by the Ministry of Communications. To each of these concerns a territorial area has been assigned.

3. 2. *General duties of bodies concerned.*

3. 2. 1. *Duties of the Administration of Transport.*

Within the Ministry of Communications, the Administration of Transport has the supervision, both technical and financial, of the whole technical inspection organization.

The Administration of Transport also controls the "Office de la Circulation Routière" (Traffic Office). This office, with the help of an electronic computer, keeps a complete, detailed and always up to date inventory of all vehicles in use in the whole country, and issues registration certificates.

This enables the Administration of Transport to allot the vehicles, for inspection, each to the particular station concerned.

3. 2. 2. *Duties of the technical inspection organization.*

Each of the ten approved inspection organisms is under the following obligations:

to own or rent buildings suitable for technical inspection (Note: inspection stations are spaced in such a way that no vehicle user should have to drive more than 20 km when summoned there).

to equip all stations in the prescribed way

to engage and use qualified personnel

to inspect the allotted vehicles in order to check whether they conform to legal prescriptions, whether their maintenance and condition are as should be, particularly from the safety point of view

to refrain from any activity other than technical inspection of motor-vehicles.

3. 2. 3. *Obligations of the public.*

The public are under the following legal obligations:

No vehicle is allowed on the roads without registration plates

The driver must have the registration certificate with him and the appropriate insurance certificate

The owner must warn the Traffic Office when ceasing to use or when selling a vehicle and also if a registration plate or certificate gets lost or destroyed

The owner must know and apply regulations concerning him on the subject of technical inspection of motor-vehicles.

3. 3. *Technical inspection layout and organization.*

3. 3. 1. *Inspection stations and their equipment.*

Belgian inspection stations today are 50 in number, totalling 126 inspection lanes. Their network covers the whole country and they actually deal with the total number of vehicles submitted to periodical inspection.

Stations are of different sizes and have from one to six inspection lanes, equipment of the latter being standardized. Each station has now also been equipped with a smokemeter. This network of inspection stations represents, on the part of the ten inspection organisms a total investment of £1,250,000.

3. 3. 2. *Inspection personnel.*

The approved establishment is as follows:

Technical personnel: 50 station chiefs, 171 inspectors, 101 assistant-inspectors.

Administrative personnel: 18 senior clerks, 157 clerks.

Total employees 497.

A training centre for technical personnel has been set up.

3. 3. 3. *Vehicles submitted to inspection.*

Are submitted to inspection: all motor-driven vehicles and their trailers except:

private cars in use since less than 5 years

motor-cycles

certain special vehicles and certain small trailers.

It is moreover compulsory to present for inspection, whatever its age, every vehicle

being handed to a new owner

put back into use after having been taken off the road

put back into use after having undergone certain alterations or repairs

imported in second-hand condition.

Inspection frequency is as follows:

Four times a year: motor-buses and motor-coaches.

Twice a year: vehicles used for carrying goods

vehicles used as taxis

vehicles on hire with or without driver

vehicles used for driver teaching.

Once a year: private cars as soon as they have been in use for five years.

3. 3. 4. *Items inspected and inspection rules.*

About one hundred items are mentioned on the inspection certificate which is practically the inspector's work programme. These items concern steering, chassis, lights, brakes, etc. . . and, as far as diesel engined vehicles are concerned, exhaust gases.

Two books are in use in every station:

A "Code of Good Practice".

A set of all legal dispositions and all regulations concerning technical inspection of motor vehicles. These have been arranged in a loose-leaf binder so that items to be checked appear in alphabetical order. For each item, only the last regulations concerning it remain in the binder.

3. 3. 5. *Administrative arrangements.*

The administrative arrangements within the technical inspection organization or in their relations with the Ministry of Communications and with other government departments are not within the scope of this paper.

Nevertheless, just to complete the picture, I will very briefly give a little information on this subject.

The ten private concerns engaged in technical inspection of motor vehicles have formed a professional group in order to ensure the coordination and continuity of their activities. This group, called "Groupement des Organismes de Contrôle Automobile" or G.O.C.A. is organized as a non-profit-making association.

The book-keeping of the inspection organisms is practically done under permanent control by the administration. Nearly all their expenses are known in advance and their returns are recorded and notified to the proper officials by means of daily lists.

Inspection rates are fixed by the Ministry of Communications and fees have to be paid by the owner of the vehicle.

The normal fee is, and has been, since March 1958:

120 Belgian francs (17s.) for a vehicle up to 3 ton maximum authorized weight.

160 Belgian francs (23s.) when the maximum authorized weight exceeds 3 ton.

From the Traffic Office, information goes out to the vehicle inspection organisms, concerning the vehicles allotted to each station, thus enabling them to summon the interested parties at the right time and also enabling them to establish their daily programmes of work to be done.

From their own files, the inspection organisms send back information to the Traffic Office, when necessary, and this helps to keep the general inventory in order and up to date.

4. Fund for Study and Research on Road Safety.

4. 1. *Origin of the Fund. Board of Directors.*

Since 1958, each technical organism is, by contract with the Ministry of Communications, required to help finance a research organization, called "Fonds d'Etudes et de Recherches relatives au Problème de la Sécurité Routière", which is a non-profit association.

The board of directors of this fund is presided over by the Director General of the Administration of Transport. The Vice-President is the President of the association of technical inspection organisms (G.O.C.A.). Other members include three high officials from the Administration of Transport and two members of the G.O.C.A. board of directors.

4. 2. *Aims and tasks of the Fund.*

The Fund was given the following aims and tasks:

(a) Study and research concerning:
technical problems of road safety principally in connection with technical inspection of motor vehicles
new devices which might benefit road safety
equipment for traffic control.

(b) Information of the Administration of Transport and of the technical inspection organisms concerning results of study and research.

(c) Help tendered to the same administration in order to solve any technical problem of the automobile in connection with safety.

(d) Management of an international documentation centre for the benefit of national and foreign technical inspection organizations.

(e) Publishing of a periodical, principally devoted to technical inspection and to all problems in relation with greater road safety.

(f) Organization of a biennial competition for the International Prize of the Fund, to reward works on a technical subject which might contribute to greater safety for motor vehicle traffic.

(g) Official standard testing of protection helmets for motorcyclists.

(h) Official standard testing of instruments for the verification of headlights.

4. 3. *The Fund's periodical: "Technical Aspects of Road Safety".*

The first number of the Fund's quarterly publication "Technical Aspects of Road Safety" appeared in March 1960.

This periodical publishes articles in French, Dutch, English and German Substantial summaries of each article are given in these four languages.

It is mentioned here mainly because it has brought its readers a certain number of papers on atmospheric pollution. A list of these papers is given in Appendix I.

5. The Problem of Diesel Exhaust Smoke from Motor Vehicles.

5. 1. *Stating the problem.*

The first important task, that the new-born Belgian "Fund for Study and Research on Road Safety" was given in 1958, was to investigate the problem of atmospheric pollution by exhaust gases from motor vehicles.

The Fund was asked to find means of reducing pollution by this source. These means had to be practical and such that the work could be done in the best economic and technical conditions.

Diesel motors had to be considered first. When poorly maintained and inefficiently operated, diesel engines emit exhaust gases with smoke and smells which offend our senses. Air pollution by petrol engines on the contrary, is not noticeable in that way, the main and very poisonous contaminant, carbon monoxide, being both invisible and odourless.

It is quite natural therefore that the public, when made air-pollution conscious, should have aimed their complaints and criticisms only at the perpetrator of the obvious misdeeds.

Besides the demands of public opinion, there were other good reasons for dealing with diesels first. Diesel smoke is certainly unpleasant, possibly harmful and sometimes a road safety hazard, whereas the principle itself of this engine is such that it can and should be operated without any emission of smoke.

There are different possible reasons for the presence of smoke in diesel exhaust, but in every instance fuel is being wasted and the life of the engine is being shortened.

It is thus in their own interest as well as for the public good that diesel users should be made to operate their engines in a rational way.

As far as diesel exhaust was concerned, the problem that the Fund was asked to solve can be stated in this way:

(a) Find the adequate instrument and the method of measurement best fitted to our aims and possibilities.
(b) In the case of several instruments and (or) several methods being found suitable, establish the necessary correlations.
(c) Work out the standards to be set.

After this it would be the task of the government services concerned to prepare the legal dispositions and the corresponding regulations.

5. 2. *Choosing an instrument and a method of measurement.*

5. 2. 1. *Preliminaries.*

The choice of an instrument resulted from inquiries which fairly soon led to the conclusion that only two apparatuses were to be taken into consideration. They were the Bosch smoketester EFAW 68 and the BP Hartridge smokemeter.

These instruments use entirely different principles:

One (Bosch) measures the density of a smoke stain on filter paper through which a certain sample of exhaust gases has been drawn, the other (Hartridge) measures continuously the percentage of light absorbed by the flow of exhaust gas sampling that passes through the instrument.

In order to conduct preliminary experiments, one instrument of each sort was bought. These experiments showed the advantages and disadvantages of each.

What we were looking for was an instrument allowing a method of measurement that would lengthen only by a few minutes the time a vehicle, undergoing the prescribed periodical inspection, normally passes in the inspection station.

It was found that the light absorption smokemeter and a method of measurement in which the vehicle remains stationary, while the free engine is accelerated through the speed range, suited our purpose best.

5. 2. 2. *Comparison of instruments.*

A more thorough investigation into the characteristics and possibilities of these two instruments was asked of Professor F. P. Malschaert, who is the Director of the Motor Vehicle Technical Laboratory at the Ghent University.

The details and results of this investigation have been published by the British Institution of Mechanical Engineers in the proceedings of the Ninth International Automobile Technical Congress held in London in 1962.

In the course of his experiments, Professor Malschaert was led to suggest certain modifications to the Hartridge Smokemeter in order to enable it to measure smoke density in exhaust gases which reach the instrument at relatively low pressure when they come from small capacity diesel engines.

The makers of the instrument eventually adopted these modifications.

Professor Malschaert's conclusions included the following:

(a) The Bosch instrument is much cheaper and lighter than the Hartridge.
(b) The Bosch instrument is much easier to use on the test bench than on the road. Its response in practice, is slow.
(c) The Hartridge instrument allows continuous measurement at rapidly varying speeds and under widely differing engine conditions. Its response is very quick. The Bosch instrument was not designed for such measurements.
(d) The modified Hartridge instrument can measure exhaust smoke under reduced dynamic pressure.

5. 2. 3. *Comparison of methods.*

In order to compare methods of measurement, the Motor Vehicle Laboratory of the University of Ghent set up a special equipment which included a four-channel recorder.

This equipment made it possible to compare the density of smoke from a number of engines of different types when operated:

(a) At successive levels of constant speed and at full injection over the whole range of speeds from slow to maximum allowed by the engine governor.
(b) At low acceleration as in the case of a vehicle travelling on the level in second or third gear.
(c) At low deceleration, as in the case of a vehicle climbing a hill in a gear too high for constant road speed to be maintained.
(d) At high deceleration with gear in neutral, the vehicle remaining stationary.

It appeared from these tests and from a large number of road tests that the maximum smoke ratings obtained by all these methods are fully comparable and that their correlation may therefore be considered sufficient for the needs of routine inspection.

The last method mentioned above is the most convenient for use in inspection stations, where there is need for one which, although simple, quick and cheap, gives repeatable and accurate results.

5. 3. *Correlation of instruments.*

A correlation curve was worked out at the Ghent University laboratories for the Hartridge and the Bosche instruments.

This curve is based on several hundred measurements, made over a whole range of constant speeds, the instruments sampling smoke simultaneously from the same exhaust.

The curve corresponds to the equation

$H=13,75\ B+4,60$

where H is the reading on the Hartridge scale, which is numbered from 0 to 100.

and where B is the reading on the Bosch scale, which is numbered from 0 to 10.

5. 4. *Practical experiments of 1960.*

5. 4. 1. *General outline.*

While the above mentioned laboratory work was being done, the Group of Vehicle Inspectors (G.O.C.A.) was asked to undertake a long series of practical experiments, in the seven principal stations, which, between them, see about half of all vehicles submitted to periodical inspection.

These stations were each provided with a Hartridge Smokemeter and their staff were taught how to use it The method of measurement chosen for the experiments was free-engine acceleration with the vehicle remaining stationary.

Every diesel-engined vehicle, driven into one of these seven stations for inspection, was to be submitted to the smoke test.

The results of the smoke measurements, together with information concerning the vehicle, were noted on a form devised for the purpose and sent to the Fund for Study and Research on Road Safety. All the data thus collected were then recorded on punched cards for statistical calculation purposes.

5. 4. 2. *Provisional regulations for the experimental period.*

One of the first and principal aims of the experiments was to test the procedure and standards adopted for the whole period.

Provisional regulations were drawn up and issued by the Administration of Transport, to be applied in the seven stations provided with a smokemeter.

All diesel-engined vehicles inspected there were classified in three groups according to the smokemeter readings. With a reading below 45 HSU (Hartridge smoke units), the vehicle was to be considered "in order". From 45 HSU upwards and as long as 75 HSU were not reached, the driver was merely warned that he might run into trouble either with his engine or with the police. Once 75 HSU were reached or exceeded, the driver was instructed to have the vehicle put in order and to show it again within the fortnight, after repairs or re-adjustments.

5. 4. 3. *Information gathered from statistical calculations.*

The data collected during 13 months, from December 1959 until December 1960, and which were recorded on punched cards, concerned more than 28,000 diesel-engined vehicles.

The distribution in three groups was as follows:

Hartridge Smoke Units	*Absolute frequency*	*Relative % frequency*
0 to 45 (excluded)	13,923	49.6
45 (included) to 75 (excluded)	11,378	40.6
75 (included) to 100	2,746	9.8
Total	28,047	100.0

Detailed statistical calculations made it possible to give valuable information to all bodies concerned.

The complete detailed figures were given to the Administration of Transport and to the Group of Vehicle Inspectors. Each inspection organism which took part in the experiments received the tables and diagrams corresponding to their participating station and to the average figures for all seven stations where smoke was measured.

Every general distributor of the principal makes of motor vehicle received the tables and diagrams corresponding to his make and to the average for all makes.

General results of the calculations were published in no. 7 (September 1961) of our quarterly (see appendix I).

5. 4. 4. *Results obtained in smoke abatement.*

To see what results could be obtained in smoke abatement, a record was kept of the smokemeter readings taken when a vehicle of the 75 to 100 HSU group came back for a new inspection after repairs or re-adjustment.

The following table shows the improved situation by comparison between "before" and "after" figures. Two-month periods are considered and also the general average.

5. 4. 5. *General conclusions drawn from the 1960 experiments.*

(a) Conclusions to be drawn from the statistical calculations appear best in Fig. 1, the S-curve diagram indicating, for every reading of the Hartridge scale, the proportion of vehicles with a smoke density below that reading. This diagram is very useful for the Administration wanting

Periods		*Average reading first inspection HSU*	*Average reading after repairs or readjustment HSU*
From	*to*		
December 1959	February 1960	87.1	51.9
March	April	88.7	53.3
May	June	88.2	49.4
July	August	87.9	51.8
September	October	87.4	52.4
November	December 1960	87.6	54.8
December 1959	December 1960	87.7	52.6

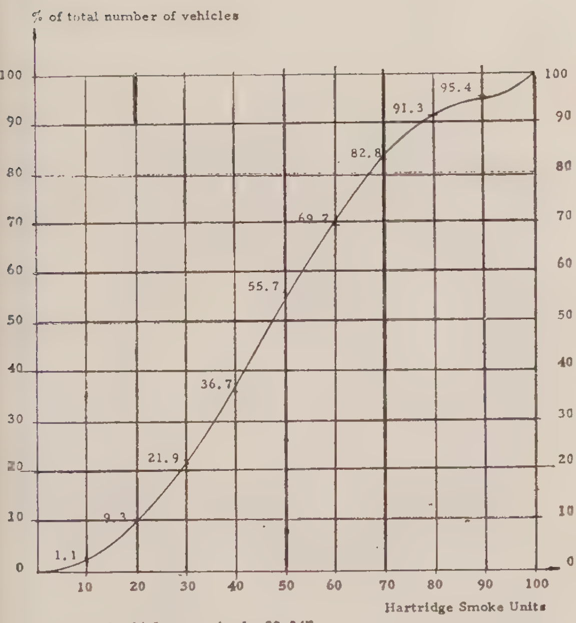
to work out regulations on diesel smoke.

When considering the standards to be imposed, expressed in HSU, a glance at the diagram shows what proportion of vehicles is affected by the choice.

(b) A vast amount of experience was gathered in 1960 by all those who, in Belgium, undertook the maintenance, tuning and repair of diesel engines. They were kept on their toes by vehicle owners who demanded effective and permanent elimination of the real causes for excessive smoke. Having thus been led themselves to measure exhaust smoke for opacity, they realized how these measurements could help them, together with the knowledge of the exact moment of maximum smoke, for the detection of engine troubles or for the planning of maintenance schedules.

DISTRIBUTION OF VEHICLES, IN % OF THEIR TOTAL NUMBER, ACCORDING TO THEIR HARTRIDGE INDEX

(cumulated relative frequencies)



Number of vehicles examined = 28.047
Period considered : Dec 59 - Dec 60

FIG. 1.

This also applies to fleet owners, with their own services and workshops, looking for improved efficiency and hating to have one of their vehicles sent back from the inspection station because of faulty maintenance.

(c) As to the vehicle inspectors, they had to watch out for all the tricks used by certain vehicle operators or drivers to reduce smoke emission temporarily, just for the duration of the inspection tests.

These are some of the usual ones:

A temporary or artificial limitation of accelerator pedal travel.

Diversion of a portion of the exhaust gas through secondary systems such as heaters or even through a second exhaust pipe discharging well away from the normal outlet.

Introduction of considerable quantities of outside air into the exhaust system (using a venturi, for instance).

Use of a wider exhaust pipe so as to reduce the speed of the gases to a level at which they fail to enter the probe.

5. 5. *Practical experiments of 1961.*

In the course of 1961, the seven inspection stations provided with a smokemeter went on with their measurements of diesel exhaust smoke and filled the usual forms for the Fund for Study and Research on Road Safety.

The experiments differed from those of the preceding year, because of a change in the provisional regulations. The consequences of this change were most interesting to study. It was decided to drop, during 1961, the rule ordering a new inspection of every vehicle whose smoke reading reached or exceeded 75 HSU. This reading was nevertheless mentioned on the vehicle's inspection certificate.

As far as the user was concerned, the inspectors merely warned him against trouble because of excessive smoke, but the obligation to have the matter seen to and to show the vehicle again had thus disappeared.

Statistical calculations with the 1961 figures led to results of which a typical sample relating to one of the participant stations is shown in Figs. 2 to 4.

Fig. 2 shows the evolution of the diagram giving the cumulated relative frequencies of smoke readings. The move towards the right of the 1961 curve means that in 1961 vehicles smoked more than the preceding year.

Fig. 3 gives, for two-month periods in 1960 and 1961, the distribution of vehicles between the three groups defined by the 45 HSU and 75 HSU limits. As far as the vehicles inspected in this station were concerned, they went back to the initial situation.

Fig. 4 brings the same conclusion, merely showing the evolution of the average smoke reading for the same periods in 1960 and 1961.

This proves that, without a minimum of enforcement, regulations lead nowhere.

6. Pollution by Exhaust Gases from Vehicles Fitted with a Petrol Engine.

6. 1. *The problem of the petrol engine.*

The real problem of atmospheric pollution by motor vehicles concerns the petrol engine. In the case of the diesel there remains no technical problem to solve: an engine that has been well conceived and manufactured, that is well tuned and maintained and that is not being used beyond its normal possibilities, will not smoke. There will be practically no carbon monoxide in the exhaust and very little atmospheric pollution will result.

DIAGRAM OF CUMULATED RELATIVE FREQUENCIES

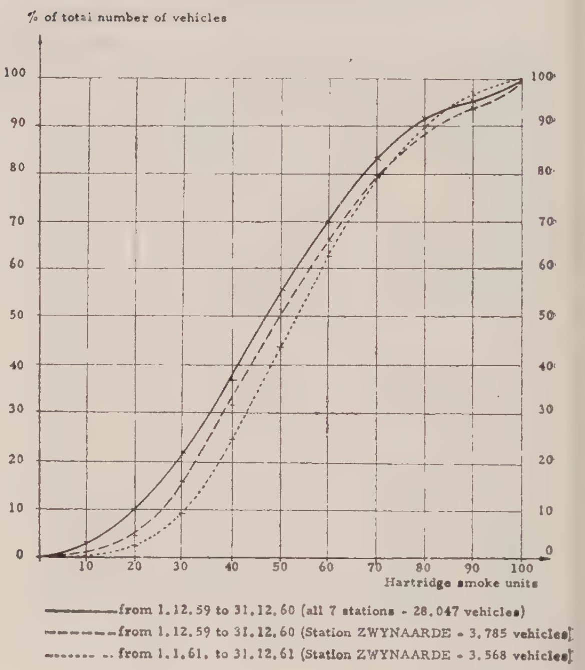


FIG. 2.

DISTRIBUTION OF VEHICLES, FOR TWO-MONTH PERIODS OVER TWO YEARS, IN THREE GROUPS DEFINED BY H.S.U. LIMITS : 0 - 45 - 75 - 100

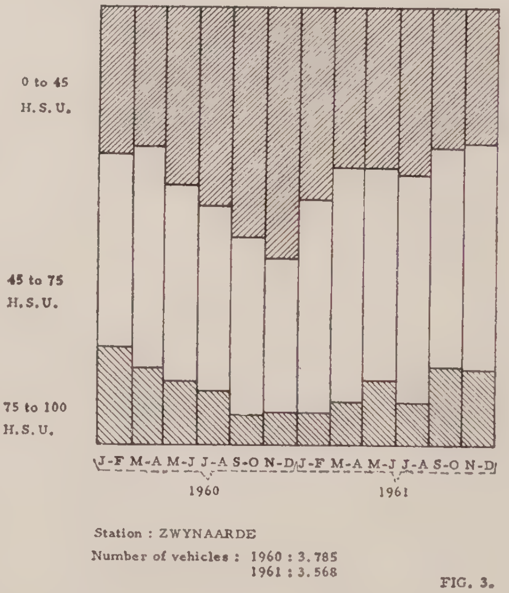
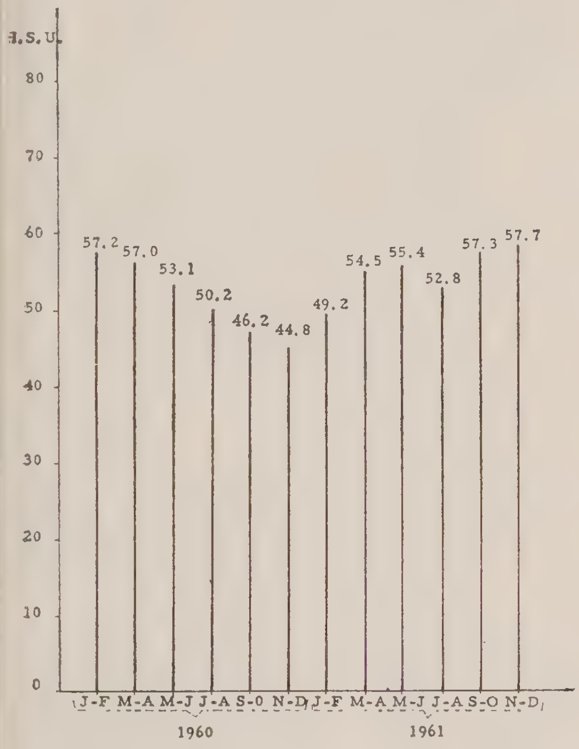


FIG. 3.

EVOLUTION OF AVERAGE EXHAUST OPACITY IN HARTRIDGE SMOKE UNITS, FOR TWO-MONTH PERIODS OVER TWO YEARS



Station : ZWYNAARDE

Number of vehicles : 1960 : 3.785
1961 : 3.568

FIG. 4.

The petrol engine, on the other hand, is conceived and made in such a way that its normal use in certain operating conditions is accompanied by the emission of exhaust gases with a proportion of carbon monoxide which in certain circumstances constitutes a definite hazard.

6. 2. *American developments.*

The American automobile industry spends very considerable sums of money for research in this field and has done so for many years already.

I have read a very interesting communications on the latest America developments in this field, written for "Smokeless Air", the journal of the National Society for Clean Air, by Mr. Arthur C. Stern of the U.S. Public Health Service.

I wish to quote just a few lines of that article:

". . . The State of California, having adopted several years ago laws requiring the use of vehicle exhaust control devices or techniques when such equipment became available to the motoring public, last summer approved four air pollution control systems after extensive testing by the State Motor Vehicle Pollution Control Board. . . .

"The automobile makers, speaking through their trade association, the Automobile Manufacturer's Association, announced previously (in March) that 1967 model cars would be modified at the factory so as to meet the California exhaust emission limitations. It is understood that the factory modifications will preclude the use of devices such as those approved by the Motor Vehicle Pollution Control Board. . . .

"A subsequent announcement by the Automobile Manufacturer's Association stated that the industry would be able to provide cars which meet the California requirements by the 1966 model year (fall of 1965), or one year earlier than had been indicated in the March statement."

6. 3. *Belgian contribution.*

As long as the problem of pollution by petrol engines of motor vehicles has not been solved there can be no question of imposing Belgian requirements concerning the carbon monoxide content of petrol engine exhaust gases.

We have not got the same means at our disposal as the Americans, indeed, as I have already pointed out, we have no motor car manufacturers, but, as 1,170,000 out of our 1,200,000 motor cars are fitted with a petrol engine, we are definitely interested and keep on the look-out for new ideas or developments.

Some time ago we were introduced to a device by which ozone could be sent into the intake and (or) the exhaust of a petrol engine in order to reduce the toxicity of the exhaust gases.

The Fund for Study and Research on Road Safety asked Professor Sibenaler, head of the Mechanical and Transport Laboratories of our Royal Military College to undertake a series of experiments with this ozonizer.

Preliminary tests made us hopeful, the device was of small dimensions and it could use the vehicle battery, so that more elaborate tests were made.

These tests have been described in our quarterly (see appendix I). Results were finally disappointing, intake ozone was without noticeable effect whilst ozone in the exhaust never induced more than a 25 per cent reduction of carbon monoxide. This not being sufficient for our purpose, the matter was dropped.

6. 4. *A French answer to the problem.*

The last issue of "Technical Aspects of Road Safety" features an article by Monsieur R. Thiebault who is Director of Technical Services at the Préfecture de Police in Paris.

This article is entitled: "An interesting experiment, made with the vehicles of the Parisian Préfecture de Police, in order to reduce the rate of carbon monoxide emitted by petrol engines.

Here is an abridgement of Monsieur Thiebault's paper.

Since 1959, the Municipal Laboratories of the Préfecture de Police have been systematically measuring atmospheric pollution in Paris, deducing the general picture from the carbon monoxide percentage. Two methods are used concurrently: one consists in periodical instantaneous sampling at more than 300 spots in the town, the other in continuous recording of the carbon monoxide rate at a given spot.

The first method has revealed some very high figures, sometimes over 200 ppm. The yearly average figures have shown a slow increase, probably linked to the increase in motor vehicle traffic.

The second method investigates the variation against time of the actual average carbon monoxide content of town air, calculated for successive 15 minute periods. The many recordings made that way have led to three main conclusions:

(a) The representative curves show practically no carbon monoxide content during the night hours from one to five, when motor traffic is scarce. The curve rises and shows a maximum at about 11 a.m. and another at about 6 p.m. A slight drop occurs between 1 and 2.30 p.m. and a slight rise towards 11 p.m.

(b) A count, within each 15 minute period, of the vehicles passing the spot that is being considered, shows a definite correlation with the corresponding carbon monoxide rate. The correlation coefficient varies however, according to the road layout, the meteorological situation and the fluidity of the traffic flow.

(c) If traffic is heavy, to the point that vehicles travel only with difficulty, the carbon monoxide curve rises. This can be taken to mean that each vehicle's contribution increases as traffic becomes less fluid.

Particularly when vehicles are stopped with motors idling and although exhaust volume is then reduced, recordings show a rise in carbon monoxide rate. This is due partly to the fact that there is less dilution and dispersion with stationary than with moving vehicles, but it is also due to the present method of adjusting carburettors, which brings about the production of exhaust gases with a high carbon monoxide content.

This has led to the idea of adjusting the idling and slow running arrangements of the carburettor so as to reduce the exhaust toxicity to a minimum without hampering the engine.

A survey of Paris traffic by the Technical Services of the Préfecture de Police disclosed the fact that when rush hour traffic is very heavy and slow, idling represents 75 per cent of the time spent on a journey. With average traffic and an occasional obstruction, idling time is 65 per cent of total time. In normal traffic conditions, idling time hardly ever falls below 50 per cent of total time.

Through another survey by the same services, it was found that by varying the two adjustment parameters: richness of the idling mixture and idling position of the throttle, it was possible to change the rate of exhaust carbon monoxide from a few thousandths to 14 per cent without change in the engine speed.

A survey of cars passing through a motor club inspection station showed exhaust carbon monoxide rates ranging from 1 to 15 per cent.

The Direction of Technical Services of the Préfecture de Police consequently worked out a method for adjusting carburettors in order to reduce the idling rate of carbon monoxide systematically.

To apply the method that was adopted, one has to proceed as follows:

Turn the idle adjustment screw until the idling mixture orifice is completely closed, then unscrew 1.5 to 2 turns.

Bring back the engine speed to the usual 650 to 700 r.p.m. prescribed by the manufacturers, by means of the throttle stop screw.

These adjustments only concern the idling arrangements and have of course no influence on the engine's performances.

The method was applied without difficulty to all 1,300 existing vehicles, whatever their make or age. Results are shown in table below where vehicles have been grouped according to the carbon monoxide proportion in their exhaust before and after adjustment.

A very pleasant consequence of these adjustments, much more important than was expected, was the air pollution abatement in a Préfecture de Police multi-storey garage for 250 vehicles.

The average carbon monoxide content of the garage air was measured in 1962 for the different hours of the day. The curve resulting from those measurements showed peaks over 100 ppm. It was decided to put in forced ventilation. This was done by October 1964.

A new series of measurements was recently taken, with ventilation system stopped, and at the same spots as in 1962 in order to measure the effect of carburettor adjustment on air pollution in the garage. Rates which in December 1962 reached 150 ppm. around 8 a.m., 97 ppm. around 11 p.m. and 180 around 8 p.m. were brought down respectively to 29, 24 and 38 ppm., that is well below the limit for physiological troubles. With ventilation on, these figures were, of course, lower still.

There are thus obvious advantages to carburettor adjustment for idling and slow-running, all the more so that engine performance is not affected.

This ought to be the subject of an education campaign for mechanics and maintenance personnel and the public should be widely informed of this possibility to arrive at healthier town air.

Before adjustment		*After adjustment*	
Distribution of vehicles	*Carbon monoxide content of exhaust*	*Distribution of vehicles*	*Carbon monoxide content of exhaust*
%	%	%	%
10.0	below 2	23.8	below 1
17.5	from 2 to 3	46.5	from 1 to 1.5
44.0	from 3 to 6	21.5	from 1.5 to 2
20.0	from 6 to 8	8.2	from 2 to 2.5
8.5	over 8	none	——
100.0	average: about 5	100.0	average: about 1.5

7. Precautions Against Air Pollution in the Belgian Vehicle Inspection Stations.

7. 1. *General data and choice of a test substance.*

The Fund for Study and Research on Road Safety was asked to consider the problem of air pollution inside the vehicle inspection stations, some time during the experiments with diesel exhaust smoke.

This problem varies from station to station, several points having to be taken into account:

Plan of building (U, I or L shape).

Number of daily inspections.

Kind of vehicles (Petrol or Diesel, heavy or light).

Local conditions (Prevailing winds, etc.).

Another aspect is the composition of exhaust gases which contain too many gaseous, condensable and solid substances to allow, in current practice, a complete and detailed analysis of the atmosphere they are polluting.

To estimate the degree of pollution it is necessary to make choice of a test-substance which is representative of the other pollutants, which is itself toxic and which can be measured easily, quickly and accurately.

In the case of pollution by exhaust gases from motor vehicles, the best and often adopted test-substance is carbon monoxide.

Carbon monoxide is an odourless and colourless gas which very readily combines with blood haemoglobin, thus causing suffocation by preventing haemoglobin from carrying oxygen from the lungs to the body tissues.

Maximum allowable concentrations (MAC.) of carbon monoxide vary considerably from author to author and from country to country.

In the U.S.A., for instance, MAC. for carbon monoxide, without the presence of other pollutants, is 100 ppm. when 8-hour periods are considered. The corresponding figure is 50 ppm. in Great Britain and 17 ppm. in the U.S.S.R.

7. 2. *Pollution levels and adoption of a pollution scale.*

When mixtures of pollutants are considered, instead of single substances, the problem becomes considerably more difficult.

The complications result either from reactions between the different pollutants or because of the presence of certain substances which, although non-toxic, act on the human body, for instance by changing the respiratory rhythym.

Research on the subject has been undertaken at the Municipal Laboratories of Paris. Carbon monoxide was chosen as test-substance for pollution by motor vehicles. The information that follows is borrowed from the published results of this investigation (see bibliography).

The chemical equation that represents the action of carbon monoxide on blood haemoglobin is:

$$\text{Hb O}_2 + \text{CO} \rightleftharpoons \text{Hb CO} + \text{O}_2 \qquad (1)$$

Taking into account the chemical properties of substances concerned and the reactions of the human body, following equation has been reached:

$$\text{Hb CO } \% = 0,16C \qquad (2)$$

where C is the carbon monoxide content (in ppm.) of the air inhaled.

Equation (2) applies to individuals remaining indefinitely in a CO polluted atmosphere. From this equation has been worked out the following table, where the presence of other pollutants has been taken into account by application of the factor 1-2 to the CO rates.

These limits may seem strict, but it must not be forgotten that they relate to the combined action of carbon monoxide and other pollutants. Besides, these figures concern averages and not peak values.

7. 3. *Mobile equipment used for measurements.*

The carbon monoxide proportion is measured by means of a type 80 "Onera" infra-red absorption analyzer. The sensibility and range of this instrument is such that it can be used to measure from 0 to 300 ppm.

The instrument comprises two vertical tubes, through one of which the air to be analyzed passes, while the other contains the appropriate stan-

Scale of pollution by motor vehicle traffic when carbon monoxide is the test-substance

Average carbon monoxide content of the air (ppm.)	*Pollution level*
0 to 5	negligible
5 to 10	slight
10 to 20	moderate
20 to 30	considerable
30 to 40	serious
40 to 50	fairly high
50 to 60	high
over 60	very serious

dard mixture. At the top end of these tubes is placed the source of infra-red rays, below the tubes the receiver.

Electric tension after the analyzer is measured and recorded by means of a potentiometric six-channel recorder.

The air to be examined is fed to the analyzer by an automatic distributor with the following tasks to perform:

(a) send on the air from six samplers taken in succession.

(b) ensure the intermediate clearances of the air tube and channels.

(c) control the synchronized recorder.

Each sampler comprises a sulphuric acid desiccator followed by a filter and a pump. These three elements, grouped in a single container, are placed as near as possible to the spot where the air is being sampled through a length of plastic pipe. Past the pump, the sampled air is being forced towards the analyzer so that a certain lack of tightness in the air pipes is without influence on measurements.

From the analyzer the gases are led outside in order to keep the pressure as constant as possible and near to atmospheric pressure. Fig. 5 gives a diagrammatic representation of the equipment.

In addition, climatologic instruments are used to record temperature, atmospheric pressure and air humidity. Finally must be mentioned a last instrument used to count the number of vehicles having entered the station during each quarter of an hour.

7. 4. *Results.*

No general conclusions are to be drawn, because of the differences mentioned above (see para. 7. 1.). Difficulties are met with particularly in the U shaped stations when evacuation of polluted air can less easily be managed.

The most polluted spots are found near ground level at the inspection pits. This affects inspectors who check

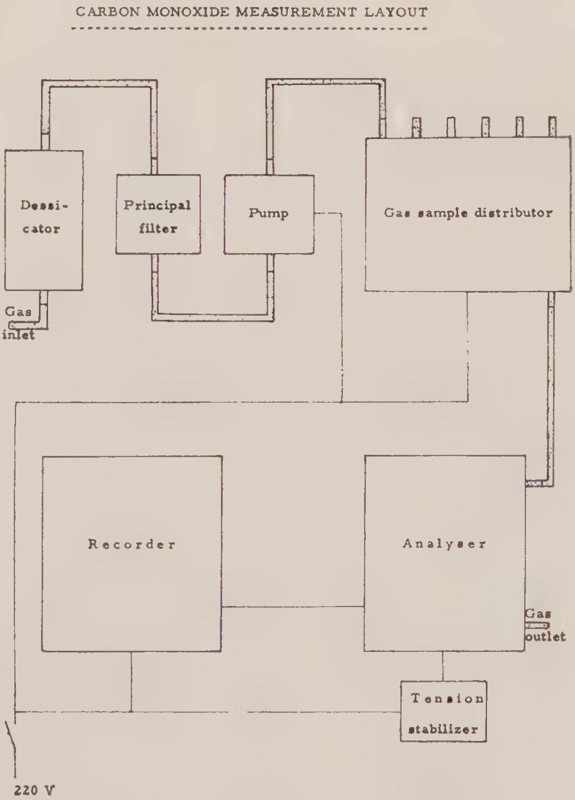


FIG. 5.

the underside of vehicles and the steering.

Momentary or localized peak values have been registered when three or four vehicles have been stopped one behind the other with their engines idling.

All this could of course be expected, but the aim has been and still is to make the inspection stations even healthier to work in by detecting the polluted spots where additional ventilation is needed and by checking the efficacy of all ventilation arrangements.

This cannot be done without adequate equipment, without a proper method of measurement and without setting appropriate standards. The information given here is only meant as a help on all three scores.

8. Present Belgian Legislation and Regulations on the Subject of Air Pollution in General and Air Pollution by Motor Vehicles.

8. 1. *Legislation against air pollution in general.*

The general law on this subject bears the date of 28 December 1964 and was gazetted in January 1965.

This is an outline of the principle articles.

Art. 1.

The King is given the power to take all appropriate measures in order to prevent or to fight atmospheric pollution, namely:

to prohibit certain definite forms of pollution
to regulate or prohibit the use of apparatuses or appliances capable of causing pollution
to require or to regulate the use of apparatuses or appliances intended to prevent or to fight pollution.

Art. 2.

Atmospheric pollution is defined, as far as the law is concerned, as any emission into the air, whatever the source, of gaseous, liquid or solid substances, capable of affecting human health, of harming animals and plants, or of causing damage to property and to sites.

Art. 3.

Royal decrees taken in virtue of Art. 1 are submitted for advice to the Higher Public Hygiene Council.

They are introduced jointly by the Minister responsible for public health, and, according to the source of pollution

the Minister responsible for mines and underground quarries
the Minister responsible for labour
the Minister responsible for public works
the Minister responsible for transport by road, water, rail and air.

In all other cases, the Minister responsible for public health acts alone. Exceptional rules, however, apply to the Minister for Defence.

Art. 4.

Concerns professional qualification.

Art. 5.

The Minister responsible for public health is entrusted with the task of co-ordinating the following tasks:

(a) Sampling and analysis of substances emitted or of air presumed to be polluted.
(b) Research concerning the effects of atmospheric pollution on human beings, animals and plants.
(c) Research on efficient means of fighting atmospheric pollution.
(d) Information of the public.

Tasks (a) to (c) are undertaken in collaboration with laboratories or public or private concerns which have been approved for this purpose by the Minister responsible for public health, in agreement with the other Minister concerned. Task (d) may be entrusted to private organizations approved by the Minister responsible for public health.

Articles 6 to 10 concern enforcement and administrative measures.

8. 2. *Legislation against air pollution by motor vehicles.*

Note: It is to be noted that the following three decrees were promulgated before the general law mentioned above came into existence. They were initiated by the Administration of Transport, a division of the Ministry of Communications.

(*a*) *Royal Decree of 30 June 1964 concerning the Highway Code.*

This decree brings a modification to one article of the highway code, concerning motor vehicle exhaust emissions. The new wording of Art.

86. 1 of the highway code is as follows:

Motor vehicles must be conditioned, maintained and operated in such a way that they do not shed abnormal quantities of oil and combustion waste, that they do not inconvenience the public or frighten animals by noise and that except for transient smoke emissions, caused namely by the starting of the engine or the changing of gears, they do not emit smoke capable of lessening road security or causing inconvenience to the other users of the road.

(*b*) *Royal Decree of 1 July 1964 to fix the conditions to be filled by Diesel-engined motor vehicles in respect of smoke emission.*

Art. 1.

Motor vehicles equipped with a diesel motor must conform, as far as smoke emission is concerned, with the provisions of the present decree.

Art. 2.

Smoke emission is defined by its opacity, measured by means of a light absorption meter using a photoelectric cell.

Follows a definition of the absorption coefficient and a few provisions concerning the instrument (measurement scale — speed of response).

Art. 3.

Concerns the conditions in which a smoke emission must be measured. [Direct reading of the instrument or use of a recording device—no storing of gases to be measured—permission to measure the whole or a sample of the exhaust).

Art. 4.

Concerns the method of measurement (high acceleration with gear in neutral, the vehicle remaining stationary) and certain precautions to be taken:

check whether the exhaust system has not been tampered with in view of the inspection

check whether the engine, on acceleration, reaches its normal engine speed.

Art. 5.

Defines the maximum allowable opacity. This opacity corresponds to an absorption coefficient of 1.280 per metre.

This figure is to be lowered later.

Art. 6.

The Minister of Communications is responsible for the type-approval of smokemeters and for working out the correspondence between the conventional reading scales of the different types and the theoretical values defined in this decree.

Art. 7. and 8.

Concern administration.

(*c*) *Ministerial Decree of 2 July 1964 bearing approval of a laboratory entrusted with the testing of smokemeters in view of their homologation.*

Art. 1.

This article entrusts the task of proceeding with the tests for the homologation of smokemeters to the Technical Motor Vehicle Laboratory of the State University of Ghent.

Art. 2.

Concerns administration.

8. 3. *Resulting situation and provisions for the near future.*

8. 3. 1. *Type—approval of a smokemeter.*

In accordance with Art. 6 of the Royal Decree of 1 July 1964, the Belgian agents for Leslie Hartridge entered their smokemeter for the homologation tests. This instrument was eventually approved and a correspondence table worked out.

8. 3. 3. *Equipment of the inspection stations.*

It has taken from November 1964 until August 1965 to provide all fifty inspection stations with a smokemeter.

8. 3. 3. *Instructions given to the vehicle inspectors with reference to the Royal Decree of 1 July 1964 method of measurement* (*cf. art. 4.*)

The vehicle being stationary and the engine at its normal operating temperature, the throttle must be fully depressed for a series of quick accelerations in rapid succession, making sure that the engine reaches each time its maximum speed of rotation.

There is to be no measurement

during the first three accelerations which serve essentially to clear soot and waste out of the exhaust system.

Starting from the fourth acceleration, the operator is to note the peak level for smoke density, indicated by the instrument during acceleration and while the engine drops back to idling speed.

The opacity to be considered is defined by the arithmetic average of the first two successive readings giving absorption coefficients per metre which differ by less than 0.074.

At the level of 50 Hartridge Smoke Units (HSU), this difference of 0.074 opacity units corresponds to 3.5 HSU.

At the level of 70 HSU, this same difference in opacity corresponds to 2 HSU.

Maximum allowable opacity (*cf. art.* 5).

Opacity may not exceed an absorption coefficient per metre of 1,280.

Translated for use of the Hartridge Smokemeter, this corresponds to 70 HSU.

8. 3. 4. *Instructions given to the vehicle inspectors concerning the inspection certificate.*

Until further notice, inspectors have been instructed to punch one hole against the indication "Smoke" of the inspection certificate for opacities ranging from 50 HSU to 70 HSU (excluded). This is the simple "warning" to the owner.

When opacity is 70 HSU or more, two holes are punched in the inspection certificate and the vehicle must be put in order and shown again within the fortnight.

APPENDIX I

Articles on atmospheric pollution published in the quarterly "Technical Aspects of Road Safety", 14, rue du Gouvernement Provisoire—Brussels I—Belgium.

Titles	*Authors*	*Nos. of issue*	*Dates*
La détection des fumées des moteurs Diesel (1).	Malschaert	3	Sept., 1960
La pollution de l'air par les véhicules automobiles (1).	Ardoullie	4	Dec., 1960
La pollution de l'air par les véhicules automobiles (2).	Ardoullie	5	Mar., 1961
La détection des fumées des moteurs Diesel (2).	Malschaert	5	Mar., 1961
Un an de mesures pratiques des fumées d'échappement de véhicules à moteur Diesel dans les principales stations du réseau belge d'inspection technique.	Coucke	7	Sept., 1961
La campagne du pneumatique et la campagne de la fumée organisées par la Préfecture de Police dans le Département de la Seine (France) en 1961.	Preaux	8	Dec., 1961
Motor vehicle pollution control in the United States.	Faith	10	June 1962
Essai de réduction de la pollution de l'air par les moteurs à essence au moyen d'ozone.	de Coster	14	June 1963
Methods of reducing pollution caused by internal combustion engines.	Jensen & Scanlin	19	Sept., 1964
Une expérience intéressante de réduction du taux d'oxyde de carbone émis par les moteurs à essence menée sur le parc automobile de la Préfecture de Police parisienne.	Thiebault	23	Sept., 1965

APPENDIX II

Bibliography

See also Appendix I.

The measurement of smoke density of exhaust gases from vehicle diesel engines, by F. P. Malschaert (in English). Proceedings of FISITA Congress 1962 (London). Publisher: Institution of Mechanical Engineers—London.

Some of the activities of the "Fonds d'Etudes et de Recherches relatives au Problème de la Sécutiré Routière" in the field of safety inspection of vehicles, by E. Coucke and J. P. de Coster (in French). Proceedings of the JIDITVA 63 conference (Brussels). Publisher: Fonds d'Etudes et de Recherches sur la Sécurité Routière —Brussels.

The measurement and control of diesel exhaust smoke emission, by J. D. Savage. Papers of the Automotive Engineering Congress 1962 (Detroit, Michigan). Publisher: Society of Automotive Engineers—New York.

Motor vehicle and air pollution, by Arthur C. Stern. "Smokeless Air", Journal of the National Society for Clean Air, no. 132, Winter, 1964.

On the choice of carbon monoxide as test-substance of pollution by exhaust gases from motor vehicles. Application to the study of atmospheric pollution of Paris in 1960 (in French), by H. Moureu, P. Chovin, L. Truffert and J. Lebbe. "Revue de la Pollution Atmosphérique" no. 14, April—June 1962. Publisher: Association pour la Prévention de la Pollution Atmosphérique—Paris.

Discussion

R. E. Waller (Medical Research Council) wished to add some further comments on Mr. Wicken's paper. However praiseworthy the motives were that had led this work to be undertaken, it appeared to him that it was too small in scale to have yielded results which could even be of local significance, let alone of national interest. Could Mr. Waller therefore ask Mr. Wicken if he could say something about the statistical significance of the differences between rates as quoted in the paper that had been heard? In that paper, little indication was given of the numbers of deaths involved in each category, but if one applied the Registrar General's criteria to the figures given in the original report, few of the differences in the lung cancer and bronchitis mortality rates were significant, and it might be necessary to reassure the people of Eston in particular that their mortality rates were not necessarily outside the normal range for England and Wales, and that the evidence that there were any differences in rates between different parts of the town was of limited validity. Mr. Waller also wished to inquire whether the pollution of Eston was really very different from that of other small urban areas of Great Britain. The comparisons which had been made in the original report gave little evidence that this was so.

Mr. Waller was particularly worried by the suggestion in Mr. Wicken's paper that local authorities might spend their own resources on surveys of that type, for at the present time both national and international organizations had been deterred from conducting further studies of mortality from chronic respiratory diseases in relation to current levels of air pollution by the formidable difficulties in obtaining meaningful results. Further progress in this field might best be made by linking the results of pollution measurements already made by local authorities as part of the National Survey of Air Pollution with the subsequent pattern of mortality in Great Britain, but even then the interpretation of results would be extremely complicated.

Dr. D. Davies (Individual Member) considered that one of the important findings in Mr. Wicken's survey was that only 48 per cent of the men who died from cancer of the lung would have done so if the overall mortality had been the same as that for the country dwellers. He was sure that Mr. Wicken would be the first to agree that it would be unwise to assume that that figure could be applied to the country as a whole.

One reason was that the Eston men appeared to have been exposed to very high pollution at work and they knew that exposure to such substances as asbestos, chromates and nickel increased the risk of developing lung cancer. Mr. Wicken might have some information about such exposure.

Another reason was that there was a risk of underestimating the cancer death rate in country people. That might not have been of any great importance in the survey but Dr. Davies raised it because some publicity had been given to the very low lung cancer mortality in rural Ireland compared with London—the implication being that, because the Irish smoking habits were not so different, atmospheric pollution was much more important than smoking. Of one thing he was quite certain—that there was a great difference between the accuracy of certification in those two areas. That was not because the Irish doctors were less able but because, in rural areas, they had fewer facilities. Country people also have a greater dislike and distrust of hospitals and the rural Irishman was sceptical of the need and desirability of subjecting himself to certain diagnostic procedures. As one chest surgeon had said "If the doctor lives twenty miles away, he only comes to sign the death certificate". And that was not the best time for making an accurate diagnosis.

It was important not to overlook the other figure that Mr. Wicken gave—that only 13 per cent of the male cancer deaths would have occurred if the rate had been the same in all as it was in the non-smokers. This was something that could be corrected much more easily and immediately, without Acts of Parliament or Ministry approval—you just stopped smoking.

G. B. Stokes (Meriden RDC) said that although Meriden was a rural district, they had a large power station complex, a large gas works (Lurgi), and now the Homefire fuel plant.

Whenever a paper on lung disease was presented to Conference, there was a noticeable reduction in the number of people in the audience smoking tobacco.

Although doubts might be cast on the conclusions to be drawn from Mr. Wicken's paper, there was no doubt whatsoever that polluted air caused ill health.

Despite the wrong impression given by the Parliamentary Secretary to the Ministry of Fuel and Power, at the opening session (that the Alkali Inspectorate were responsible for clearing up all pollution from industrial sources) the local authorities and their health inspectors still had a lot to do in reducing air pollution from both industrial and domestic sources and while the outside air was being improved it was important to keep in mind the levels of pollution which occurred inside buildings, at meetings and functions in particular.

D. Jenney (Dorman Long (Steel) Limited) said the Health Committee of Eston were to be congratulated on sponsoring this survey but the report conclusions were misleading as in North Eston the social habits, population density, damp housing etc. had not been given sufficient significance. All conditions should be improved but it should be noted that the worst area was better than Sheffield and the national average. The report could infer the area was dirty whereas Middlesbrough had run second to Bath the previous year in the "Britain in Bloom" competition.

It was to be appreciated that his industry was a member of the Society and supported it. They were, of course, responsible to the Alkali Inspectorate and endorsed the Minister's statement regarding their relations with industry. Industry was spending large amounts of money to maintain clean air and in his own Company in the Eston area over £3 million had been spent in the past few years and schemes of approximately £1 million were being considered.

With regard to high sulphur in heavy fuel oil they were now consuming approximately 5,000 tons per week of this oil but with a sulphur content better than gas oil.

Dr. C. F. Lynch (Dover) speaking to the paper by Mr. E. Coucke, suggested that in addition to the need for further research into methods of controlling carbon monoxide emissions from petrol engines, there was an urgent need to control the use of the motor car itself.

He referred in particular to the problem caused by the large volume of motor traffic through the Road of Dover, to and from the Continent. The bulk of this traffic he said had to pass through the centre of the town where serious traffic jams were frequent and at such times the build-up of carbon monoxide at breathing level had to reach excessively harmful concentrations.

He suggested ways and means by which non-essential car users might be controlled—at least in the local circumstances referred to—and felt strongly that restrictions were called for generally in respect of motor vehicles of all kinds.

Road casualties alone he thought should be sufficient for the matter to be taken more seriously.

He was afraid that if the increasing number of motor vehicles on the roads went unchecked, their contribution to air pollution and accident mortality was bound to increase, despite all efforts for clean air and road safety, with disastrous results in the long run to motorists and pedestrians alike.

F. Colbert (Stoke-on-Trent) said that Mr. Betz had given an excellent paper on Odour Control by Catalytic Combustion. His figures on the economics of the process were most helpful. He pointed out that it was left to local authorities to attempt to enforce the production of clean and odour-free air without any really empirical legislation to assist them.

A research station, similar to the building research station, could be set up where special pilot models could be used to obtain all necessary data to prove processes before proceeding with main deodorizing plant design. This could be a great help in solving some of our present fume emission problems.

Mr. Colbert gave details of some of the work in this field that had finally proved successful in his local authority.

A serious nuisance existed in the northern part of his city by reason of the evolution of hydrogen sulphide from organic and high sulphate material tipped in a worked-out clay pit. The Chemist reported on smells; the smell of H_2S was probably the result of anaerobic fermentation of organic material and the bacteriological break-down of sulphates at the bottom of the marl pit. The sulphates having originated by the "leaching" out of soluble sulphates from the debris of which the tip was constructed. The following action and results might be of interest to the Conference; attempts to try oxygenating of the water (90 feet deep) to lead to a reduction in bacteriological break-down of sulphates in solution proved unsuccessful. This method had apparently been used to good effect in the south of the country where tipping in shallow wet pits occurred. Attempts to cover the surface with debris to reduce the emission of H_2S from the surface gave no material help.

Dumping of soda ash into the water proved very successful and had been used since to good effect on another marl hole used for tipping. Those results were obtained from aiming at a target of pH above 8.5.

With offensive trades the passing of polluted air through a furnace was now recognized as very bad practice.

A good standard was being attained with (1) condensers and deodorizers and (2) pressure melters and water sprays for the effluents from those types of premises.

Mr. Colbert wished to ask Mr. Betz a question regarding bone calcining. Provided the fumes were collected, was catalytic combustion a practical method in the fume control from bone calcining works?

Dr. K. Gräfe (Individual Member, Hamburg, W. Germany) asked whether Mr. Betz was able to guarantee that the smell of trimethylamines would not be detected in the off-gases of fish-meal factories if catalytic combustion was used? If Mr. Betz were able to guarantee this Dr. Gräfe proposed to inform the VDI in Dusseldorf about such a possibility, because VDI intended to issue a draft regulation about the off-gases of fish-meal factories. During a conference German industry wanted a figure of 20 mg/m^3, an expert of Hamburg demanded 1 mg/m^3, the compromise proposed was 10 mg/m^3. German experts were convinced that it would continue to smell extremely offensively if 1 mg/m^3 was not to be guaranteed.

Dr. J. L. Burn (Salford) stated that catalytic control was not always complete. Breakdowns occurred. The existing legislation in the Public Health Act 1936 was inadequate to deal with offensive odours. The increasing development of industrial processes resulted in areas in the vicinity of "Best Practicable Means" virtually nullifying action.

To deal with odours it was necessary to prove either they were prejudicial to health or a nuisance. It should not be necessary to prove either in order to eliminate odours. It should be essential to install suitable equipment to reduce or eliminate odours instead of merely venting to atmosphere as so often happened.

The Clean Air Act 1956, if it was to live up to its title, had to deal with odours as well as smoke, grit or dust. Under this Act it was not necessary to prove nuisance; in the case of smoke it was merely necessary to prove emission irrespective of whether it was prejudicial to health or a nuisance.

The Clean Air Act could be extended to deal with odours in the same manner as smoke. In addition, processes prone to such odours could be scheduled and the installation of suitable deodorizing equipment made compulsory.

D. Lister (Northumberland) expressed his interest in Col. Coucke's paper as giving details of a method of control of smoking diesel-engined vehicles which he himself had been advocating for the past eight years. Whilst conceding that Belgium was fortunate in being a small country having a relatively small number of commercial vehicles to supervise, he commended this approach to the problem, especially the use of the smokemeter, by means of which the "permitted limit" for smoke could from time to time, as and when circumstances allowed, be lowered without difficulty.

To obtain the striking improvement alleged in the experiment with the Paris police cars suggested that the original carburettor settings must have been far from the optimum. There was little doubt that the idle settings of cars in general use did show wide variations, but he was not sure that such spectacular results would be obtained by applying the rule-of-thumb technique described to all cars indiscriminately. The best way of setting a carburettor was undoubtedly by using a simple exhaust-gas analyser and many service stations now possessed such equipment.

Mr. Lister asked Col. Coucke (a) whether in his vehicle inspection routine any regard was paid to excessive smoke from petrol engines due to excessive consumption of lubricating oil, and (b) whether there was any likelihood of an additional test being included in the future for assessment of CO emission.

H. Parkinson (Grimsby) asked Mr. Betz if he had any information about the complete elimination of stinks from fishmeal works and any effective measures for dealing with sulphides emitted from "man-made" fibre factories.

W. Combey (Oxford) expressed interest in this matter, as consideration had been given some years ago to the use of catalysts in connection with paint odours from a car factory at Cowley. It was, however, discovered that poisoning of catalysts was likely to occur very quickly and, because of the enormous load likely to be borne by the system, it was felt uneconomic to pursue it. Unfortunately, odour problems still prevailed, thought to be due to breakdown of certain basic pigments in some paints, and experiments were continuing in the hope that a solution to the problem might be found. Could the speaker indicate whether further discoveries had been made in the use of catalysts which could reduce the effects of poisoning and so reduce expense?

Authors' Replies

Mr. Wicken said that the survey described in the paper was not designed to give results applicable to the country as a whole, but to investigate variations in lung cancer and bronchitis mortality in the Tees-side area. The research was therefore carried out on a scale which, though relatively small, was adequate for the purpose of measuring the kinds of differences found to prevail. The results should not, of course, be taken as applying to England and Wales generally.

The information obtained in the survey was subjected to recognized statistical tests, the results of which were quoted in the original report. For example, there was less than one chance in 100 that the difference found between the lung cancer and bronchitis mortality rates for North and South Eston could have occurred by chance.

The evidence presented, in the original report, on the levels of mortality and air pollution in Eston compared with England and Wales as a whole was less comprehensive than that presented on the levels of mortality and air pollution within the areas studied. For this reason the original report did not emphasize the results of the comparison between Eston U.D. and the rest of England and Wales.

No information about exposure to particular substances such as asbestos, chromates and nickel, was available. Nor was it possible to assess the differences in diagnostic standards, if any, between urban and rural districts in the Tees-side area. It was therefore not possible to estimate to what extent, if at all, the rural lung cancer rate was under-estimated relative to the urban rate. In any case, it was unlikely that the main findings of the survey would have been affected since a difference similar to the rural/urban difference was found within Eston U.D. itself.

Epidemiological studies of the sorts of problem tackled by this research were complicated and difficult to conduct. That they could be carried out satisfactorily on a small scale and provide results which were both interesting and useful in the conduct of local affairs had, however, been demonstrated by this particular survey.

Mr. Betz, replying to Mr. F. Colbert, said that with regard to pilot model tests for proving a deodorizing process before proceeding with main installation, he could announce the approach his company would take in 1966. They would offer a complete *problem survey*, including a study of ventilation techniques, measurements and adjustments to obtain optimal exhaust air volume, chemical analysis of odorous constituents as well as pilot tests to prove the effectiveness of the equipment. After this survey the company would propose corrective methods and submit tenders for fume elimination equipment. The latter could be of their own manufacture or manufactured by other well-known companies in this field.

Fumes from bone calcining could be treated with the catalytic method. Two problems were generally encountered, however. One was the high dust content of the fume stream from the calcining kiln and the other the large exhaust volume from the bone storage facilities. Both could be dealt with. A complete survey of the manufacturing plant was required, however, and the most advanced ventilation techniques must be employed. A combination of a reliable dust removal apparatus with the catalytic system must be made in order to obtain complete odour removal from the calcining exhaust.

Replying to Dr. K. Gräfe, Dr. Betz said that much the same which was said about bone calcining was also true for fish-meal factories. While it was difficult to give a general guarantee, an odour-free effluent could be obtained with the catalytic method. A survey must first be made of the plant and equipment and the most advanced ventilation techniques must reduce the ventilation volume to the optimum. This generally brought total equipment cost within reasonable limits.

In reply to Dr. J. L. Burn, Dr. Betz said that catalytic equipment deserved the daily care of any industrial equipment. It must be designed under strict engineering standards or the results would be less than satisfactory. In all the applications of this equipment around the world (now well over 8000 installations) catalyst break-down or poisoning appeared at a rate of only one case in about 2000.

In reply to Mr. H. Parkinson, Dr. Betz said that sulphides could be thermally decomposed to sulphur dioxide. When considering the economics of the process, one must again keep the ventilation rates in mind. It could be done at reasonable cost. Although SO_2 was less offensive than sulphide vapour, it still created a problem. Recent developments of multifilm washing devices had made the SO_2 removal possible. These methods were not inexpensive to operate and the urgency of the problem must be a guide line when considering feasibility.

In reply to Mr. Combey, Dr. Betz said that exhaust vapours from automotive drying ovens were cleaned by the catalytic process in many installations in the United States and Europe. In no case had they experienced poisoning or actual breakdown of the catalyst. Some units were operating with a catalyst life of 35,000 hours and more. The problem here again was the adjustment of the oven ventilation system and air recycling system to bring the size of the catalytic unit within reasonable limits. It appeared that the systems in the Cowley installation had been overloaded.

Proper system design was required here as in many other applications. Mostly however, was the work required to obtain the engineering design perameters done without due consideration. But unless proper design information was obtained before installing a unit, poor results would be obtained.

Mr. Coucke, in replying to the questions asked by Mr. Lister, said, with reference to smoke from petrol engines, that only diesel-engined vehicles were submitted to the smoke test in Belgian vehicle inspection stations. It was, however, to be borne in mind that the emission of excessive smoke by petrol engines was an offence against the Belgian highway code (see article 86.1, of which an English translation appears in paragraph 8.2 of his paper).

With respect to an additional test for assessment of CO emission, Mr. Coucke said that the addition of such a test would almost certainly be contemplated as soon as the appropriate equipment had been successfully designed, manufactured and tested. What the technical inspection organization needed, was an instrument allowing the use of a simple, reliable and quick method of measuring the proportion of CO in exhaust gases. This was the indispensable condition for including that test in normal inspection practice.

New Horizons in Domestic Heating

OIL

by

H. R. Brewster[*]

ABSTRACT

In developing new techniques for applying oil heating to domestic premises the oil industry has the spur of competition within its ranks as well as the pressures from gas, solid fuel and electricity. Every new development must therefore be commercially viable, and show some advantage over competitive means of heating. Since oil is burned smokelessly it has an important part to play in smoke control areas and in clearing the air in areas yet to be scheduled. In addition, the very low sulphur content of light domestic fuel oil results in a considerable reduction of SO_2 emission from low level chimneys where oil firing replaces open fires in domestic premises.

To meet the requirements of the modern well insulated dwelling new oil firing equipment is coming on to the market, providing low cost heating. Units are available for the living room giving radiant heating and convection, with or without hot water, and with capacity to give a measure of air heating to the rest of the dwelling. There are also new central units providing air heating for the whole dwelling, together with domestic hot water. These may either be built into brick structure during building construction, or be supplied as complete prefabricated assemblies. Operation is simple, and capital and running costs low.

If new equipment is to be successful then it must be installed and maintained properly. In order to achieve this, suitable training must be provided for the trade. This is already being done, courses being given for Maintenance Engineers, Installers and Installer Executives. As a direct result of this training, standards of installation have risen considerably, and they will continue to rise in the future. For new houses, the provision of a piped and metered oil supply offers great scope for development and can be of particular interest to local authorities concerned with redevelopment of certain types of older property. In district heating, as in industry generally, oil will take its part based on the advantages of ease of delivery, compact storage and the degree of automatic operation that can be provided.

The distribution networks of the Oil Companies provide reliable rapid fuel delivery everywhere in the country and these facilities are expanded in step with growth of demand and refining and production capacity. Oil will play a very important part in reducing atmospheric pollution whilst providing better standards of heating.

THIS is a Clean Air Conference. It is not therefore my task to "sell" oil-firing for heating, but to deal in a factual manner with present and future concepts of the heating of domestic premises; the part which oil does, and will play as the heat source for these purposes; and the contribution which oil-firing makes to clean air.

Since the overall title of these talks is "New Horizons", I shall of course refer to future plans and new developments, but I must make one thing clear at the outset. The Oil Industry is a highly competitive industry; we are in direct competition, not only with other oil companies but with gas, coal and electricity. These three nationalized industries may have many difficulties to contend with, but they do have certain marketing advantages, such as complete monopoly over their own markets. Whilst my Company and the Oil Industry have a very great investment in the future development of oil-fired domestic heating, this investment has got to pay for itself in a highly competitive market. I hope, therefore, you will forgive me if I say that I have no intention of putting before you all our plans, all our ideas, or all the investigations which will lead to *our* New Horizons—we do not want to find that horizon too crowded when we get there!

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Oil, Smokeless Heating

Particularly when used in domestic premises, oil may be considered as a smokeless fuel. There are good reasons for not classifying oil with gas, electricity and other smokeless fuels in the Clean Air Act, but for the purposes of domestic heating the use of oil compares very closely with that of towns gas. There are, for example, blue flame burners which will not produce visible smoke even if overfuelled, or partially starved of air. When we had a burner testing laboratory at Fulham, (between the gas works and the power station) it was a standing joke that distillate fuel burners produced smoke readings of 0 to 1, whilst the laboratory atmosphere gave a reading of 1 to 2—it was cleaner *in* a boiler than outside!

In the past two years, there has been great controversy over the availability of solid smokeless fuels, and even over the peak load capacity of the gas and electricity supply systems. The one source of smokeless heating which has never been in question is the petroleum industry. Indeed, the growing flexibility of the gas industry is based upon the wide use of light petroleum products. At this Conference last year Mr. E. Rendall mentioned the world position regarding future availability of oil supplies, and I will not bore you by repeating these facts. Exploration continues, exploitation of oil fields continues, and new areas of oil production continue to be expanded. The refinery building and expansion plans for the U.K. continue to bring new plant on stream to meet the increase of fuel consumption with growing population and industrial activity. In 1964 and 1965, some eleven groups announced plans for refinery construction or expansion in the U.K.; a rough estimate of cost would be £100m. These schemes are due to come "on stream" in the period 1965–1970, and will expand this country's refining capacity by over 30m tons per annum. So you may be assured that the Petroleum Industry can match any marketing plans with world fuel resources and U.K. refining capacity to ensure ample supplies of suitable fuels for the whole country.

Oil Fuels for Domestic Heating

So much has already been spoken and written about the petroleum fuels used for domestic heating that I will not dwell long on the subject. The greatest expansion in individual home heating, indeed some 90 per cent of all new heating installations, will be in property requiring less than 60,000 Btu/hr. of heat. For this size of heating system there is a light domestic fuel oil with a very low sulphur content (below 0·08 per cent), which is the predominant fuel in the domestic market. For the minority of larger individual systems, the appropriate fuel is a slightly heavier distillate. This is also low in sulphur and typical figures for both these fuels are given in Table A below.

Where individual heating systems are used, many of the dwellings will be one or two-storey properties, detached, semi-detached, or terraced. These places will have relatively low chimneys and it is important that the fuels burned should be both smokeless and low in sulphur, since flue gas dispersion will always present problems, particularly in certain weather conditions.

TABLE A

Petroleum Fuels for Single Family Dwellings

Description	*Approx. kinematic viscosity (c/s)*	*Typical* Sulphur Content*	*Heat value (Gross) Btu/gal.*	*Approx. average cost per gross therm†*
Light Domestic Fuel Oil	2·0 @ 60°F	0·08% 0·004 lb./therm	158,100	12.7 pence
Domestic Fuel Oil	5·0 @ 60°F (34 secs. Red.I @ 100°F)	0·8% 0·04 lb./therm	164,000	11·2 pence

* See Page 12 "Sulphur Dioxide" published by the Technical Committee of the N.S.C.A.

† In appropriate delivery quantities, 200 gal. L.D.F.O., 500 gal. D.F.O. Outer zone prices.

When we turn to blocks of flats, and to heating large developments from central boiler houses, the boiler size is such that the cheaper fuels may be burnt and flue gas dispersion from single relatively tall chimney structures or from the top of tower blocks, is a much simpler problem.

Reduction of Atmospheric Pollution

As I said earlier, the interests of this Conference must centre round the reduction of atmospheric pollution, and I propose to set down clearly some of the factors which must be considered in relation to oil burning and our ultimate aim of the maximum possible reduction of all forms of pollution.

Smoke is not a matter of concern to us. All oil-fired boiler plant which, in accordance with the Clean Air Act (Statutory Instrument 541) is correctly designed or adapted, installed, maintained and operated, will burn without the emission of visible smoke. Indeed, we go further than this and employ flue gas sampling techniques to ensure that really clean combustion is achieved. With domestic equipment, burning distillate fuels, a smoke number is an adequate assessment of combustion quality. It is our view that all individual domestic appliances should be capable of continuous operation with a smoke number of less than 2. Modern equipment by leading manufacturers reaches this standard, and if you recall my comment about the Fulham laboratory atmosphere having a higher smoke number than this, you will realize how very high the standard is set. When we consider boiler plant for larger schemes such as group or district heating, a smoke number is no longer an adequate assessment of combustion performance. Again, special techniques are employed for determining the total stack solids emission from boiler plant, and again modern equipment achieves extremely high standards of cleanliness. We expect future recommendations from the Ministry of Housing and Local Government regarding solids emission from the larger boiler plant to reflect the high standards that can be achieved by modern oil burning equipment.

To ensure satisfactory trouble-free service, all equipment must be properly installed and properly serviced. A full understanding of the job is very essential. Let me quote you two problems that arise, which are closely connected with a lack of understanding at the design stage of boiler installation. The immediate means of cure, and our long-term plans to ensure a better understanding at the design stage lead to one of our New Horizons. (Furthermore, it is a horizon on which we shall welcome crowds.)

If domestic boilers are subjected to flue conditions for which they are not designed, or if the boilers are oversized or fitted to sluggish systems or systems with bad control arrangements so as to cause excessively frequent on-off cycling, then there is a chance of a smell nuisance being created. This is usually outside, but if flue conditions are very bad, a nuisance may be caused in the house. Given the right advice by people who fully understand the problem, almost every case can be made satisfactory, usually without excessive expense. Great strides have been made over the past two years and the number of installations which give offence is very small indeed.

If we now look to the bigger boiler, suitable for group or district heating, we must make sure that the design of the whole plant, especially flues and chimneys, is such that no smuts will be formed. We have now a vast fund of experience in curing smut problems and many solutions are very simple indeed. These troubles are, however, unlikely to occur in the circumstances of district heating, since the full resources of our knowledge will be available at the design stages. In such capital-intensive schemes, correct initial design is of paramount importance.

I hope you all read *Smokeless Air*, the N.S.C.A. quarterly journal? On Page 259 of the Summer issue, it announced what I regard as a single early step toward the New Horizon of 100 per cent satisfactory installation work. This is the broadening of the activities of a Warren Spring Laboratory Advisory Panel, to give guidance on the two types of problem which I have mentioned above. People buying fuel from major oil companies have direct access to technical advisory services; the job of the Panel is to direct problem cases to the right source of advice if this is not immediately available through the fuel supplier.

Training of installers is extremely important. For example, we have a Training Centre which is capable of handling six courses of 20 members at any one time, with an anticipated throughput of 5–6,000 trainees per year. Whilst the annual throughput of trainees may not be a very big percentage of all fitters installing heating systems, these trained men represent a nucleus of good practice, and we believe that, like yeast, "a little leaveneth the whole lump".

Except in the case of electricity (where large central thermal stations burn coal or oil at what, from a heating point of view, is relatively low thermal efficiency), heating of dwellings requires the combustion of fuel on a fairly localized basis. It may be burned within the householders' own premises, or possibly in a boiler plant serving a number of dwellings. I propose to take this division of heating method, and consider the future developments in oil-fired heating on the basis of single and multiple dwelling heating and fuelling systems.

Individual Heating Systems

These may be "wet systems" using radiators skirting heating, and possibly some natural or forced convection units, or they may be "dry" systems using heated air as the heat transfer medium. Particularly in the medium and large sized homes, oil-fired boilers have for many years provided cheap automatic heating, the fuel being stored in tanks which may be in many shapes and forms to fit the circumstances of the site, and may be disguised in many ways to blend with their surroundings.

Central Storage Systems

In the future provision of Parker Morris Standard heating for dwellings below 1,100 sq. ft. where the capital cost of the total heating system for each dwelling must be kept low and where it is desirable to avoid multiple deliveries, it is now possible to provide continuous oil supply. This development, which although current and possibly known to many of you, is still relatively new and we are just beginning to see the scope of its potential. The system provides an oil distribution network with metered connections to each dwelling, rather similar to the distribution arrangements for towns gas. The concept is a simple one, though there were many engineering problems to solve before a simple and reliable system was

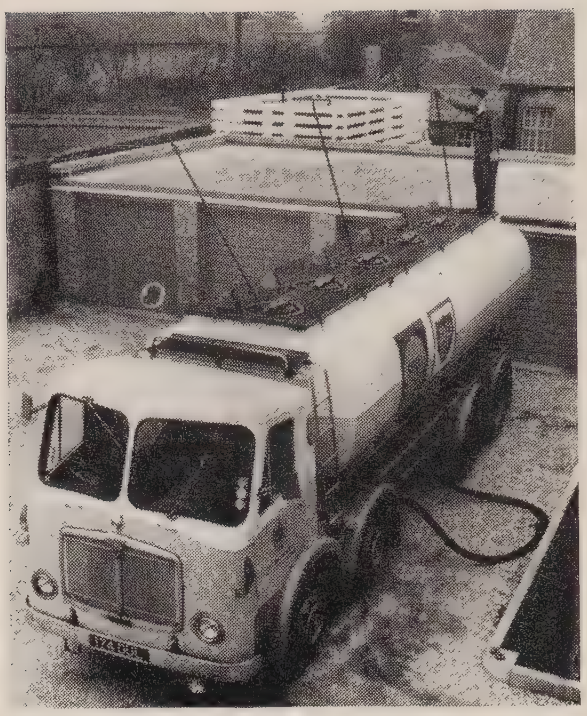

Fig. 1

evolved. A large tank is situated unobtrusively near an estate of houses or block of flats. From this tank, fuel supplies are piped to each home, where the oil is metered before being fed to the individual boiler or air heater.

There are many advantages to this system of fuel distribution. Firstly the need for individual tanks is eliminated, making it much simpler to apply oil-firing to certain types of development, including the redevelopment of blocks of older Local Authority housing, such as "backs to backs". The fuel supplier owns and pays for the storage tank and distribution system, and the householder is assured of a continuous supply of oil, since the supplying company ensures that an adequate stock of fuel is maintained. The individual householder has his heating system completely under his own control, and uses a fuel which is ideal for smoke control areas, one which will operate fully automatic heating equipment cheaply, and which brings to areas of low level chimneys a fuel which both burns without smoke and is very low in sulphur content.

Positive displacement meters are used, built to fine precision limits rather like a watch, which measure the oil with accuracy similar to electricity and gas meters. These oil meters are sited in an outside wall, so that they can be read without disturbing the householder.

Tanks are frequently housed as extensions to garage blocks or blended into other constructional features on development sites, or may be screened by trees or shrubs. A typical example of this arrangement is shown in Fig. 1.

The interest shown by developers, and the rate at which systems are now being installed is proof of the considerable advantages being offered by this means of distributing oil fuel, and I believe the future will see a very wide extension of this safe, clean, unobtrusive method of providing cheap metered fuel for domestic heating.

Heating Equipment for Single Family Dwellings

Whether supplied from individual tanks or from central storage schemes, the domestic dwelling provides a considerable challenge to the ingenuity of heating equipment designers, manufacturers and installers. The modern oil-fired boiler, similar in appearance to the smaller domestic refrigerator and just as quiet, is well established and too well-known to need description here. However, with the growing awareness of the need for satisfactory heating, there is a very large demand for low-capital cost systems for the smaller house, particularly for the new housing estates.

The days when the main heat source in these dwellings was an old-fashioned solid fuel-fired back boiler, helped by an electric immersion heater, are passing rapidly. One of the new horizons which we see is the rapid growth of the use of oil in simple, cheap heating units, needing no attention apart from a brief annual service, and providing hot air, hot water, and in some cases radiant heat. These appliances are already available in relatively small numbers and may be roughly classified into two groups. Those designed for the living room, and those designed for siting as a core unit in the centre of the dwelling, or in the kitchen.

Living room appliances may present some visual evidence of heating in the form of hot ceramic radiants similar to a gas fire, glowing metallic grilles, or luminous flame behind a glass window. An example of one of these appliances is shown in Fig. 2. For those who have conquered the habits based on open fires, there are units which give no visible glow, but both types give some radiant heat from the structure as well as convected hot air, and in most cases an optional boiler section giving all the necessary domestic hot water. In the open plan house, the convected heat is sufficient to give comfortable conditions in the upstairs rooms, there being also a considerable heat transfer through the living room ceiling. In houses with smaller living rooms, some convection may be established through open doorways, but a high level fan and return air grille have been found to transfer warm air very satisfactorily into hall, staircase and upstairs rooms. This system of heating, giving complete comfort in the living room, plenty of domestic hot water, and a very acceptable level of upstairs warming, is one which I consider will provide improved heating standards for many thousands of families in the next few years; at low-capital cost, and with very economical running costs. Not only will this development provide cheap oil-firing for smoke control areas, but reduce atmospheric pollution in other areas by providing efficient heating based again on very low sulphur fuel which will burn without smoke or dust.

For the central core unit, there are several variations on the theme, each with its own application to particular methods of building and type of dwelling. A number of Local Authorities are very interested in certain types for their own housing programmes. Briefly the variants range from the equipment for building into what we term a "Brick Central" construction, to a complete prefabricated core unit for incorporation in factory built housing. The basic brick central unit consists of an oil-fired heat exchanger with a water jacket or coil. Air heating is by natural convection through the central brick chamber in which the heat exchanger is housed. Where it is desirable to avoid the building of a chamber on site, prefabricated chambers can be used, or the whole unit, including casing, may be a factory assembled structure. The choice will be with the Local Authority or the private developer as to how much is incorporated in the central structure, from the simpler air heater with hot water supply, to a complete prefabricated central service unit including hot and cold water supply, soil pipe and all plumbing connections.

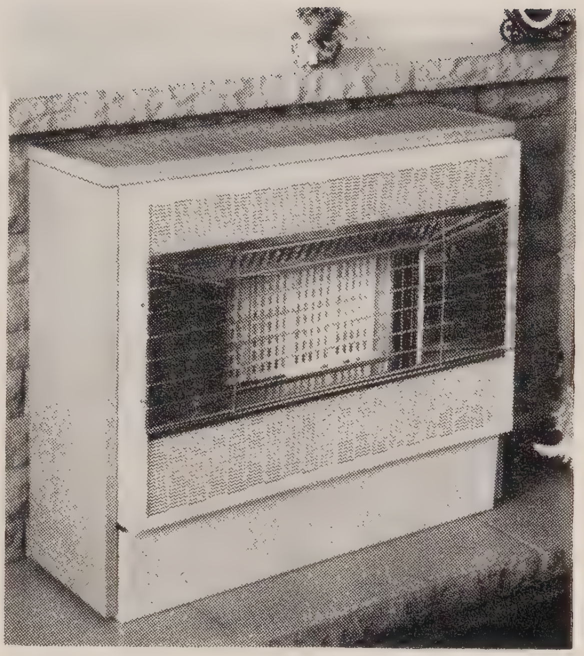

Fig. 2

District or Group Heating

It is an interesting fact that on certain large sites where distribution of hot water from a central station has been considered, we have found that the phasing of the development has been so difficult that the use of several central oil distribution systems would ultimately prove more satisfactory. However, interest in the heating of numerous dwellings from a central heat generating station has grown steadily, to the point where

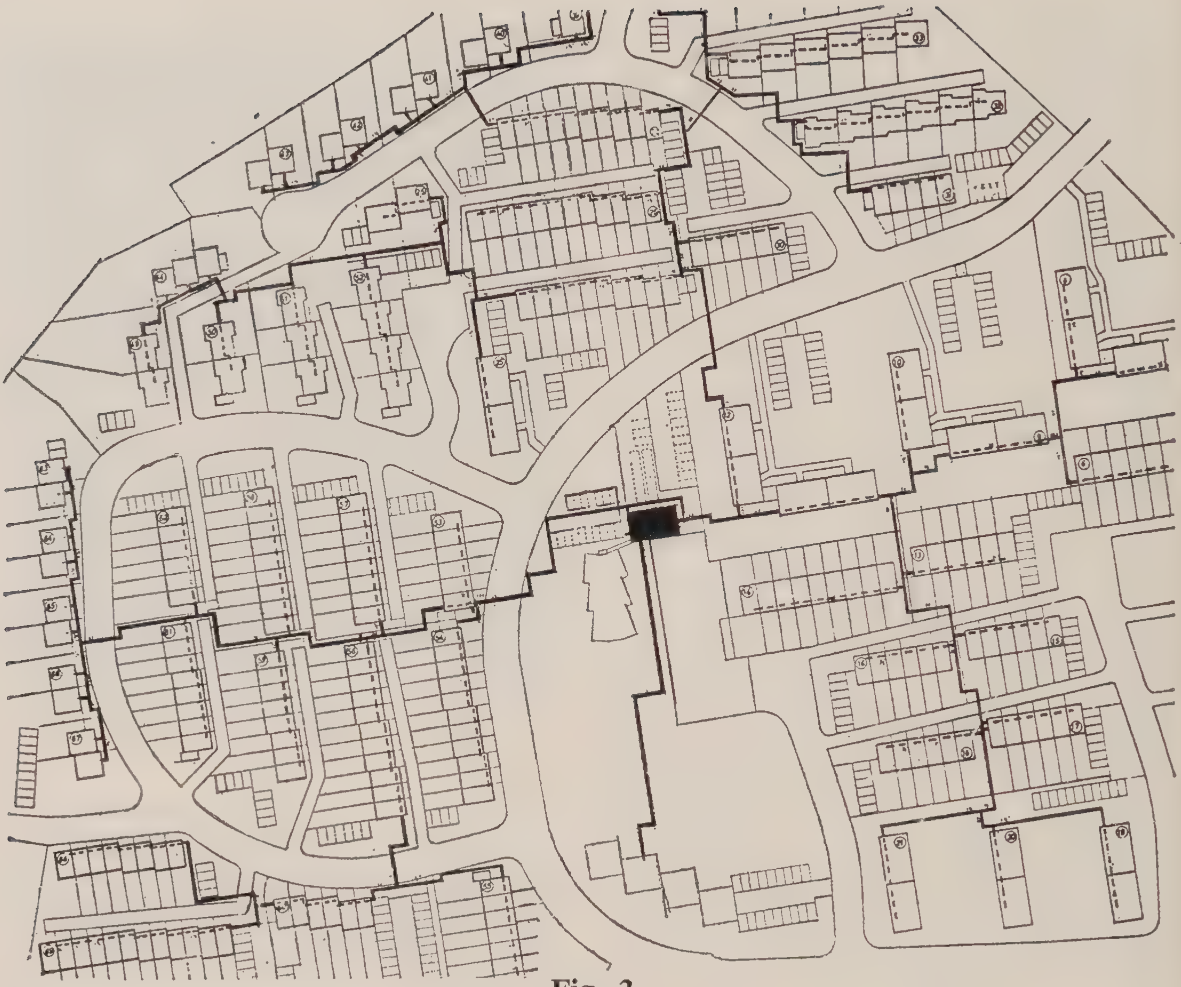

Fig. 3

hardly a week passes without some mention of district heating in the general trade, or technical press. As you may well expect, we receive innumerable requests for guidance, assistance, and information on district heating, and the Groups to which my Company belongs have very close contacts with district heating schemes in other parts of Europe.

Some idea of the scope of a district heating scheme may be obtained from the diagram, Fig. 3, showing a typical mains system as applied to a town in Germany. The boiler house is in the centre and the layout is such that appreciable lengths of main pipework can be taken through the structure of the buildings heated. By this means, the extent of insulated, buried mains may be reduced and therefore the cost of trenching, backfilling and moisture proofing.

The essential economic principles behind the use of district heating are relatively simple. At each individual dwelling, there is a saving of capital cost due to the elimination of boiler, fuel storage and handling equipment, and chimney. The relatively high grade fuel necessary for burning in small appliances is replaced by cheaper fuels which can be burned efficiently in a large central plant. Individual servicing is also reduced. The total capacity of the central boiler plant may be less than the sum of all the small units eliminated, because of the reduction of "cumulative safety margins" and the diversity factor of heat utilization. The savings outlined provide a capital figure and a reduction of running cost against which must be set the capital cost of mains, metering, central boiler and pumphouse, the chimney and main storage and handling. The interest, however, on this capital must be paid, together with the labour charges incurred in operating a continuous heat service. I shall refer to some of these items later when considering the particular role of oil fuel, but for the present it will suffice to say that the ratio of central station cost to mains/metering costs must fall within certain limits for a scheme to be viable, and in each case this will set a lower limit to the average density of heat load. Heavy central loading may pay for low density fringes or even long runs to high consumption points may provide the base load to "carry" low density offtakes along the line, but essentially the average load density must be fairly high to justify a scheme. Equally, the cost of the boiler house and fuel handling equipment, the value of the site area devoted to these services, and the labour costs, must be kept low in relation to the total heat load. Continental experience is not always a complete or satisfactory guide to appropriate development routes in this country. This excellent means of heating homes requires some adjustment of the user's attitude to the value of heat in his premises, and acceptance of methods of assessing usage and charging for heat which, whilst generally accepted on the Continent, represent a new concept to people in Great Britain. Furthermore, our soil conditions are such as to make the engineering considerations more critical. High water table on parts of sites, clay intrusions at various levels on undulating sites, and made-up land all present problems. Either developers must be geographically selective in choosing sites, or the higher cost of becoming independent of site soil conditions has to be accepted.

It would appear that the National Coal Board have decided the long-term coal contracts represented by group or district heating schemes are desirable business, and worth the investment of capital to obtain security of tenure. One advantage may be the flexibility of fuel quality requirement which could be built into such schemes if the right equipment were installed. This flexibility would apply whether solid fuels or petroleum fuels were chosen for particular sites, and the ability to use the cheapest fuel available has aroused the interest of many classes of developer including private and local authority sectors. The total amount of fuel burned, when related to the capital cost of a scheme, makes one realize that each of these schemes must be economically satisfactory in terms of investment and service of capital, and cannot be regarded as just another means of increasing sales of a particular fuel. Having accepted this fact, it becomes clear that viable schemes of group or district heating will become matters for consideration by numerous organizations interested in large scale finance, and choice of fuel will then be made in much the same way as for present industrial heat requirements, based on fuel and equipment costs, amenity value and supply position.

Since the heat distribution network is likely to be very much the same whether oil or coal is the fuel chosen, I propose to avoid duplication with N.C.B. speakers, and will not go into any detail on this aspect; I will give some consideration to the part likely to be played by oil in fuelling district heating schemes, and refer to some of the more general advantages of this approach to heating which detailed consideration of individual schemes may not highlight.

Reduction of Ground Level Pollution

One of the more cogent arguments in favour of large centralized heating stations is the reduction of ground level pollution that can be achieved, compared with conventional solid fuel heating in individual open fires, stoves or boilers. Not only is the overall thermal efficiency likely to be raised so that less fuel is burned for the same heat requirement, but the products of combustion arising from the generation of this heat may be emitted from a single tall chimney, possibly sited on the leeward side of a development in relation to the prevailing wind. This argument is very sound if the alternative is to burn, under numerous chimneys with low level terminals, fuels which may cause smoke and certainly produce appreciable amounts of sulphur dioxide. However, when comparing the central boiler house with individual gas or light domestic fuel oil boilers, this point does not carry so much weight.

Oil as a Fuel for Group or District Heating

In the long term, the total heat load to be carried by central stations will rest on the economic facts of cost per therm of heat delivered to the ultimate "user" of that therm. Amenity, reduction of atmospheric pollution, and other aesthetic considerations will play some part and may sway certain decisions on cases where the economics show little to choose between group or individual systems. I would therefore put down the following factors, which in my view will decide the relative places of oil and coal in providing the heat source for these schemes.

Fuel has to be won, or imported and refined. It is therefore available at a limited number of points in the U.K., and must then be transported to the site of use. The cost per gross therm delivered to site must therefore reflect pit-head or ex-refinery prices and haulage cost, but this is very far from the final consideration so far as the "fuelling cost" of a heating scheme is concerned. Labour charges must be kept low and therefore the maximum degree of automatic operation must be achieved. On some schemes, the value of boiler house and fuel storage sites are not of major importance, but in the long-term view this factor must be considered. The duty of providing a continuous service to very large numbers of householders, commercial and possibly industrial consumers makes the question of fuel storage assume considerable importance. Even with relatively short hauls, the capital investment in vehicles to provide fuel at the consumption rate at maximum loading must be balanced against storage site cost. With a comprehensive national delivery service, simple delivery arrangements and compact storage facilities, it is clear that oil fuel can satisfy many of these requirements very competitively, and in the long run oil fuel will take its economic share in the fuelling of group and district heating schemes.

All these schemes are, however, so capital-intensive that no particular interests can hope to finance more than a few projects in the immediate future. In the long run, group or district heating schemes must stand on their own overall economic merits, but there is no doubt these heating systems, with their many advantages, will have a definite place in the overall heating pattern in this country. Early decisions by local authorities or fuel interests regarding investment in these schemes may hasten or retard the adoption in this country of the principles of district heating, but in the long run the principles will stand or fall on their economics and the choice of fuel will be one factor. The part played by oil in district heating is unlikely to differ largely from the part taken in other spheres such as process steam generation, and factory space heating.

The oil industry has played a very important part in the post-war economic growth of this country. Our technologists have co-operated with all the leading industries to develop better methods of heat utilization, to achieve higher productivity, to produce better products, and to set standards of fuel economy and reduction of atmospheric pollution which are very high indeed. With the economic growth has come a generally higher standard of living, and a steadily increasing awareness of the importance of environmental hygiene and comfort. Reduction of atmospheric pollution and the provision of clean, labour-free, but still cheap heating are key factors in this improvement of living conditions. I think I have said enough to show that the oil industry is very conscious of the role it has to play in the future, and that modern methods of utilization give petroleum fuels a place in all types of property development, in every part of the country.

Because of the demand for a rising standard of life, the domestic market for heating is expanding rapidly, and it is my view that for a long time to come all the fuel industries can look forward to steadily increasing business in the domestic heating sphere. What we are all, in fact, selling is heat and comfort in the home. The need is for better and cheaper equipment, better and more economical installation work, and the careful integration of new equipment development with new concepts of town development and building techniques.

At the beginning of my talk, I mentioned the growth of refining capacity, the increasing exploitation of present oil fields, and the continued exploration for new oil fields. We must not forget the steady development of distribution facilities in this country. Local authorities looking into availability of fuels for proposed smoke control areas have found, and will always find, local distribution networks for handling burning oils and domestic fuel oils in every part of the country. Together with the equipment manufacturers, we can take our part in providing heating without atmospheric pollution, and our own expansion is planned in such a way as to try and always be in advance of the demand for fuels.

GAS

by

*R. N. Bruce**

O.B.E., T.D., B.A., B.Sc., M.I.GasE.

ABSTRACT

The new and economic methods of gas production based on the steam reforming of light petroleum fractions at high pressures are described. The types of gas produced are almost free from sulphur as are the stack gases discharged by these plants into the atmosphere. They thus make an even greater contribution to clean air than the obsolescent traditional coal carbonizing plants.

The various methods of enriching lean gases by refrigerated natural gas, liquid petroleum gases, refinery gases and the new Gas Council processes, all of which are substantially sulphur free, are also described. The part which could be played by other sources of natural gas, such as those which might be discovered in the North Sea, is discussed.

The increasing part which Towns gas is playing in the clean air campaign is also considered; this is due to the increasing public demand for this competitive, piped, clean fuel. Annual increases in gas demand are estimated to be 8 per cent due particularly to the development of:
(1) new highly efficient convector gas room heaters; (2) whole house heating by ducted warm air systems; (3) small bore gas central heating systems also providing domestic hot water; backed up by promotional price tariffs.

Figures illustrating this increase in demand, e.g. a sale of nearly one million fires in the year 1964-1965, and further possible increases based on experience in the United States of America when plentiful supplies of natural gas were made available are discussed.

Finally, the evidence of the public's increasing choice of gas for house heating when given freedom of choice is substantiated by independent testimony.

Introduction

I AM very pleased to have been invited to give this address on the "Future of Gas in the Home" in the session of your Conference entitled "New horizons in Domestic Heating", as there is no doubt that the changes now taking place and those which could take place in the foreseeable future could revolutionize the use of gas in the home, as it has already done in the United States of America and is beginning to do in Western Europe.

Such a change would have an increasing effect in promoting clean air in this country. Fifty years ago pollution of our atmosphere was visibly seen in the shape of choking 'pea soup' fogs which occurred regularly each winter, consisting of a visible and invisible element—the former composed of finely divided carbonaceous or gritty particles, and the latter of sulphurous gases derived from burning many different types of fuel in either industrial or domestic appliances. The visible proportion of pollution has decreased considerably but there is still much sulphur being discharged invisibly into the air at the present time.

The Gas Industry now has an even greater opportunity of playing its part in the elimination of both these objectionable features of our present way of life and of providing a clean fuel service at an economic price both to the country as a whole—from a capital point of view—and to the individual customer in respect of what he actually pays for. I will try to tell you what we are doing to this end under two headings:

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* *Chairman, South Eastern Gas Board*

(*a*) New methods of manufacture and the types of gas they produce.
(*b*) Modern domestic gas appliances and their increased efficiency.

New Methods of Manufacture and the Types of Gas they Produce

Nearly all the new plant which is being erected at the present time is based on the steam reforming of light naphtha at high pressures. These processes ultimately produce hydrogen which is then enriched in a variety of ways to produce Towns gas.

Light naphtha could be described as an oil fraction corresponding to a low grade petrol. It has the great advantage that it has a low sulphur content of about 200 parts per million, which in the process is virtually completely eliminated; thus the gas reaching the customers' appliances is sulphur free. When burnt there is therefore no sulphur dioxide in the products of combustion and thus no addition of this harmful substance to the atmosphere. It has the further advantage from the point of view of our industry that the effect of corrosion on appliances is almost eliminated making maintenance problems much easier.

There is, however, a further contribution to the clean air campaign in that the process of making gas in this way is almost self-supporting thermally. The reforming furnaces are normally fired by the same light naphtha which produces little if any sulphur dioxide in the combustion products which go up the stack of the plant to atmosphere, compared with the traditional carbonizing plants which had some contribution in both ash and sulphur content to make to the atmosphere.

The main enrichers are—

1. Purified refinery gas.
2. Liquid petroleum gases such as propane or butane.
3. Methane, which I shall mention again later.
4. High calorific gases produced from light naphtha by one of two processes developed by the Gas Industry at its Midland Research Station at Solihull. They have been named the catalytic rich gas process (C.R.G.), and the gas recycle hydrogenator (G.R.H.).

All these enrichers have a very low sulphur content and thus have again the desirable effect on clean air by not adding any sulphur pollution to the atmosphere. Fig. 1 shows the layout of the newest plant inaugurated this year at Avonmouth; this incorporates a G.R.H. plant and is an entirely different conception from the traditional coal carbonization plant. These new reformers are further illustrated in Figs. 2 and 3. Their advantages are—

(*a*) Low operating costs. The cost of production of gas is between 7d and 8d a therm compared with the cost of production by carbonizing coal, which, if new plants of this kind were built at the present time, would cost nearly double this figure. Thus coal is being phased out as a basic fuel for gas production—in itself a contribution to clean air as has been pointed out.

(*b*) Low comparative capital costs. The Minister of Power, when answering a Parliamentary question in February 1964, gave the following figures for capital costs—

Electricity Generation

Atomic	£97 per kw
Coal-fired	£34 per kw
Oil-fired	£32 per kw

Gas Making

Oil reforming £8 per kw equivalent. A minimum of 4 : 1 and a maximum of 12 : 1 in capital costs in favour of gas. A most significant saving of scarce capital resources of the nation.

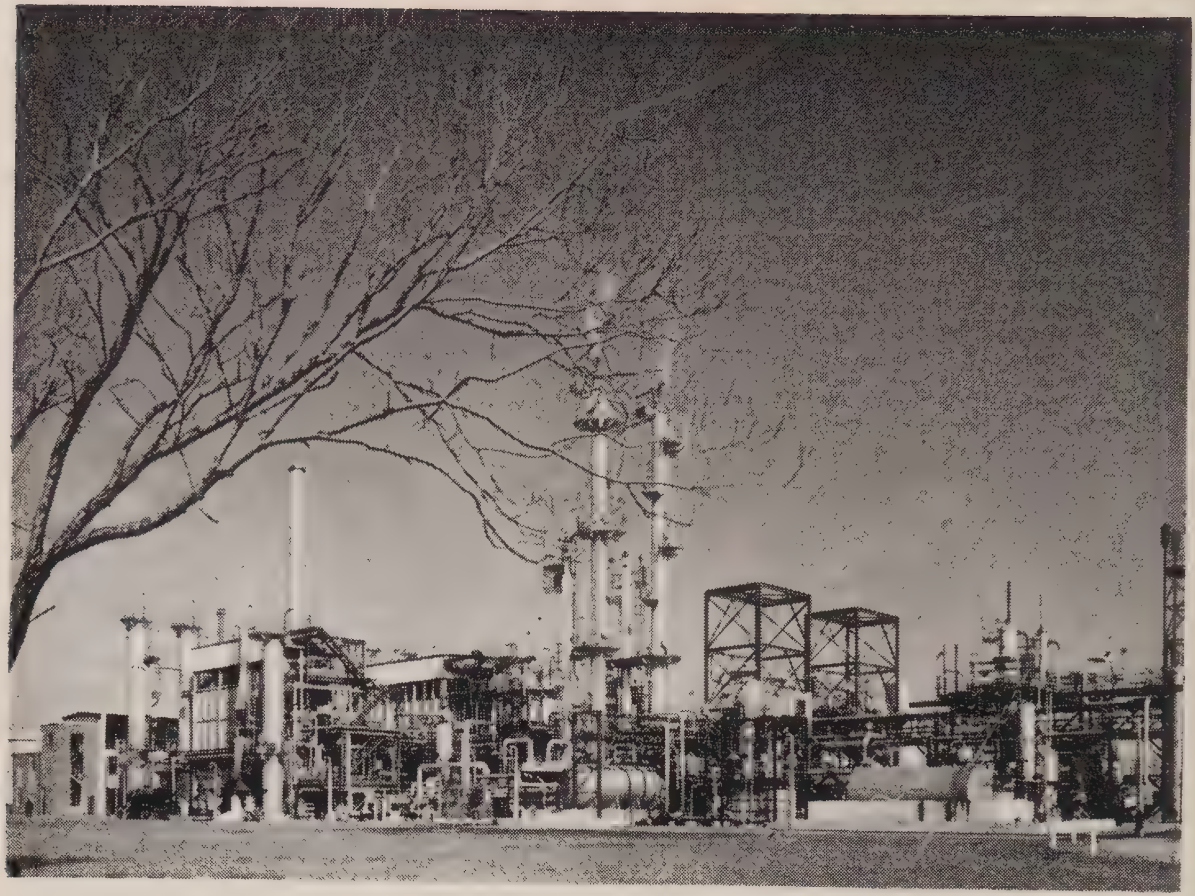

Fig. 1

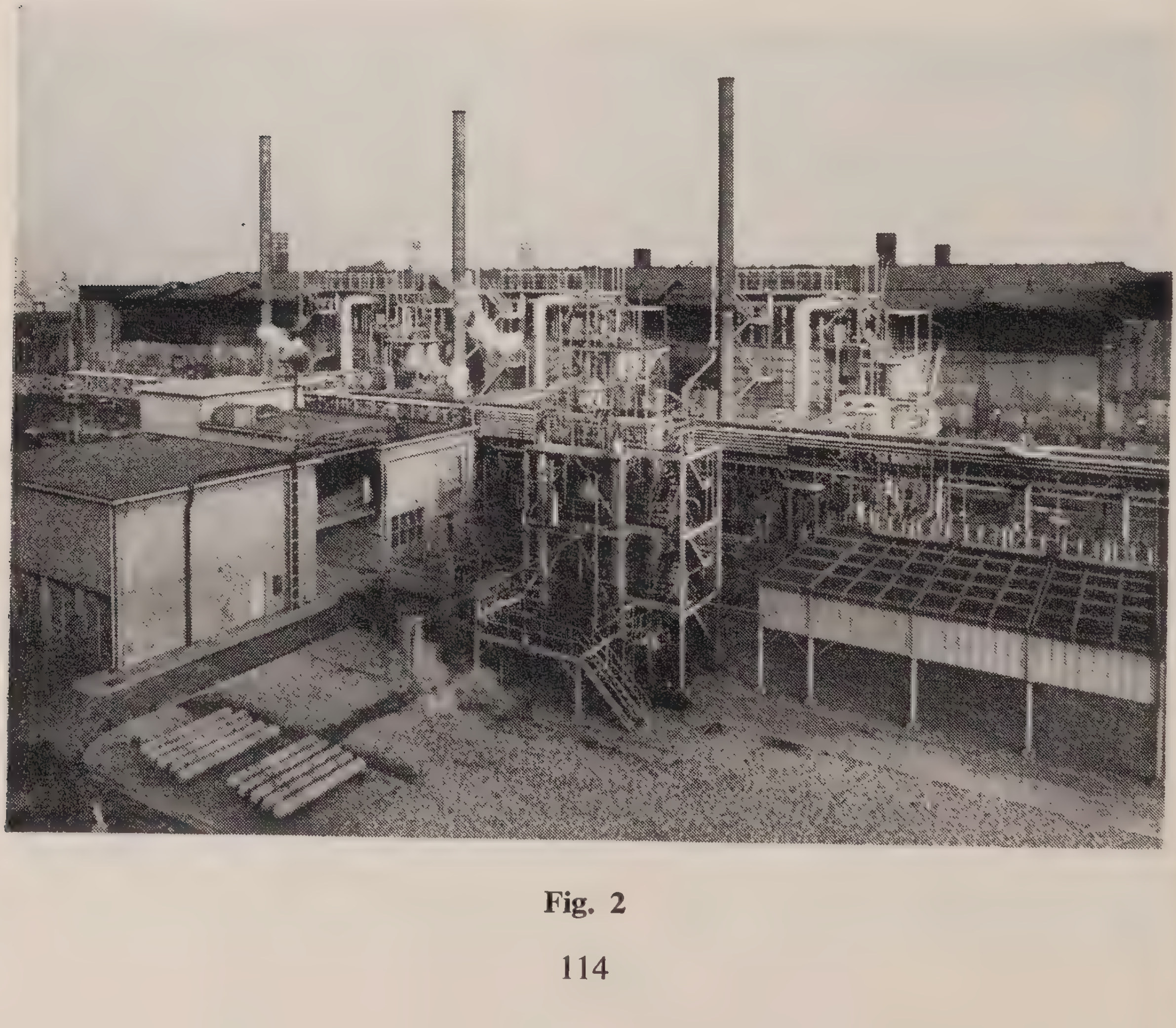

Fig. 2

(*c*) The thermal conversion ratio of naphtha to gas is of the order of 90 per cent and the gas produced is practically non-toxic, as any carbon monoxide formed in the reforming process is later converted into hydrogen and carbon dioxide. The only addition to atmosphere through the plant stack is therefore harmless products of water vapour and carbon dioxide.

(*d*) As the gas is produced at high pressures, a maximum at present of 450 lbs. per square inch, it can be transmitted over long distances without extra compression costs. It has also been estimated that the cost of bulk transmission of gas by underground high pressure pipelines is considerably less than transmission costs of equivalent energy by high voltage overhead electricity lines. It also has the advantage that there are little or no fuel losses on the way.

To give some idea of the scope of these new reforming and ancillary plants: there are under construction or in operation plants with a total capacity of over 2,000 mill. cu. ft. per day, which is equivalent to more than 75 per cent of the present installed capacity of the industry as a whole (1964). Apart from these new plants there are either available at the present time, or potentially available, large quantities of natural gas in one form or another, all of which, as has already been mentioned, are in effect sulphur free, and thus when used either as a gasmaking feedstock or as an enricher, or perhaps later as a primary fuel, will make an even greater contribution to clean air. There are three possible sources—

Liquefied Natural Gas

There are vast quantities of natural gas in the world which are at present not being used or are going to waste. The Gas Industry ten years ago pioneered experiments to liquefy gas by refrigerating it to —265°F and transport it in specially designed ships carrying about 11,000 tons per ship. The gas is not under pressure but only liquefied, which reduces it to 1/600th of its original volume, thus making it economical to move in this way.

When it was proved that this method of transport was viable, two ships: the "Methane Progress" and the "Methane Princess" were built (Fig. 4) each making a round trip voyage of eleven days to Algeria and back. They make a contribution at present of about 10 per cent of the Industry's requirements.

This enterprise required the building, by separate Companies of Algerian, American and French interests, of a pipeline 24″ in diameter and 260 miles long, and a refrigeration storage plant and seaport (Fig. 5) on virgin land in Algeria needing 100,000 h.p. for cooling the gas, as well as a new terminal, built on behalf of the Gas Industry, at Canvey Island on the

Fig. 3

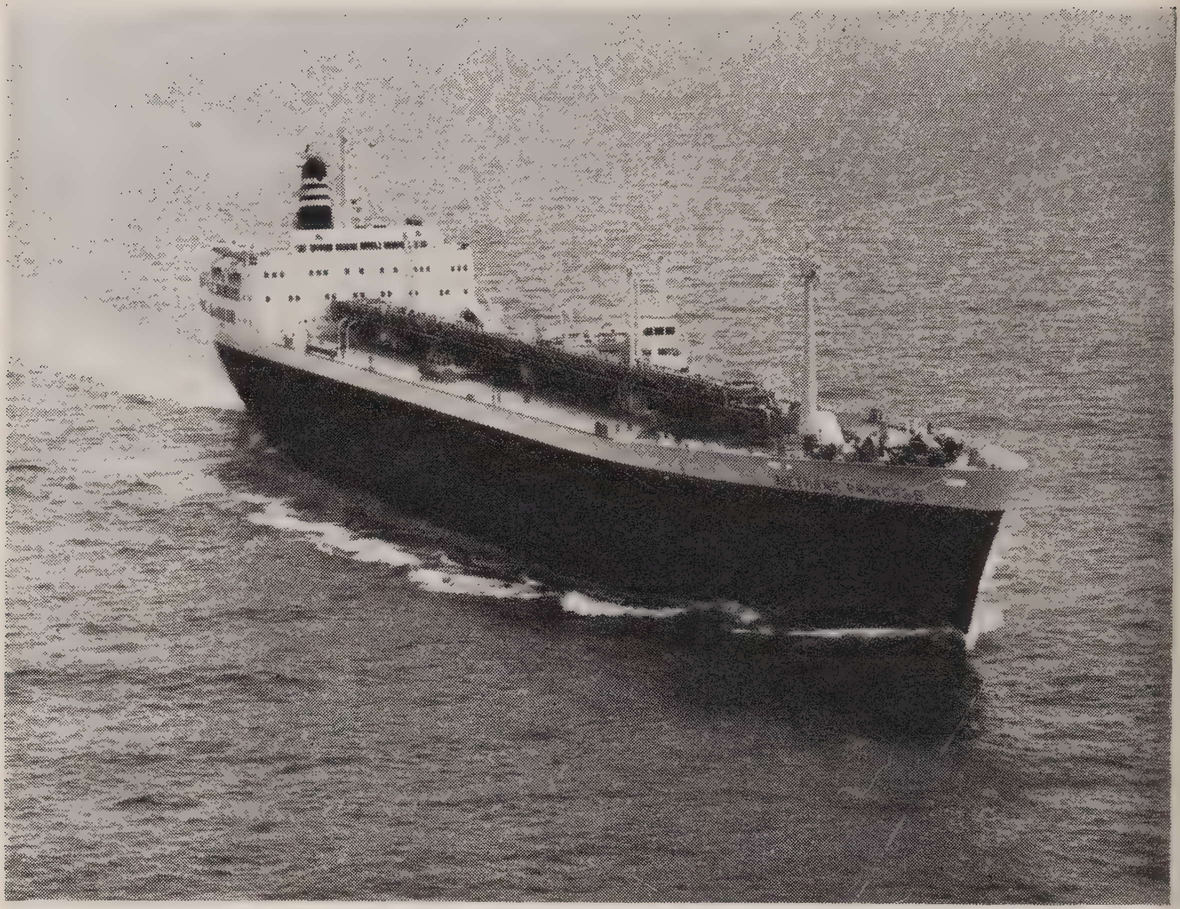

Fig. 4

Thames estuary, to store up to 22,000 tons of the liquid in insulated (but not refrigerated) tanks (Fig. 6). The liquid is then warmed up by means of a heat cycle based on Thames water, thus generating its own pressure and pumping the gas through a 350 mile trunk main system to eight Area Gas Boards. The route of the main is illustrated in Fig. 7.

If any of you are further interested in this pioneering project, there is an excellent film available from the Gas Council which describes all these associated activities in a simple but detailed way.

Gas from Holland

Exploration for natural gas has been going on in Holland for over ten years but it has only been in the last three years that real success has been achieved. Mention is made here as the known reserves are such that there is already an exportable surplus and it is possible that some could be made available for the British Gas Industry. The quantities are very large: to put the matter into perspective the amounts are between 100 and 150 times the annual consumption of gas in Great Britain at the present time. Supplies will soon be going to Germany, Belgium and Northern France.

The question of this country obtaining supplies is basically one of economics. The cost of a pipeline from Holland would undoubtedly be high and there would be considerable technological problems to be solved in laying a pipeline across the North Sea. However, this possible source of supply of a clean fuel should not be eliminated. Joint technical studies of the feasibility of such a project are being undertaken at the present time without the commitment of either party to an eventual agreement.

North Sea Gas

This is the $64,000 question!
Is there gas or oil under the North Sea?
If so, in what quantities?

Fig. 5

The answer is: no one knows, but great efforts are being made to find out. The first phase, that of seismic survey, has to a large extent been completed. Most of the major Oil Companies and the Gas Council itself in partnership with major oil interests have, over the last two years, spent appreciable sums in charting the geological structures below the sea bed on the British side of the North Sea.

Licences to drill and produce have been let by the Government to a number of enterprises, and the accompanying map (Fig. 8) shows the areas in which licences have been allocated to the major interested parties. Your attention is drawn to the areas which have been allotted to the Gas Industry and its Associates.

The second stage has now started: that of drilling at the most likely spots with a view to proving the existence and extent of oil or natural gas. This

Fig. 6

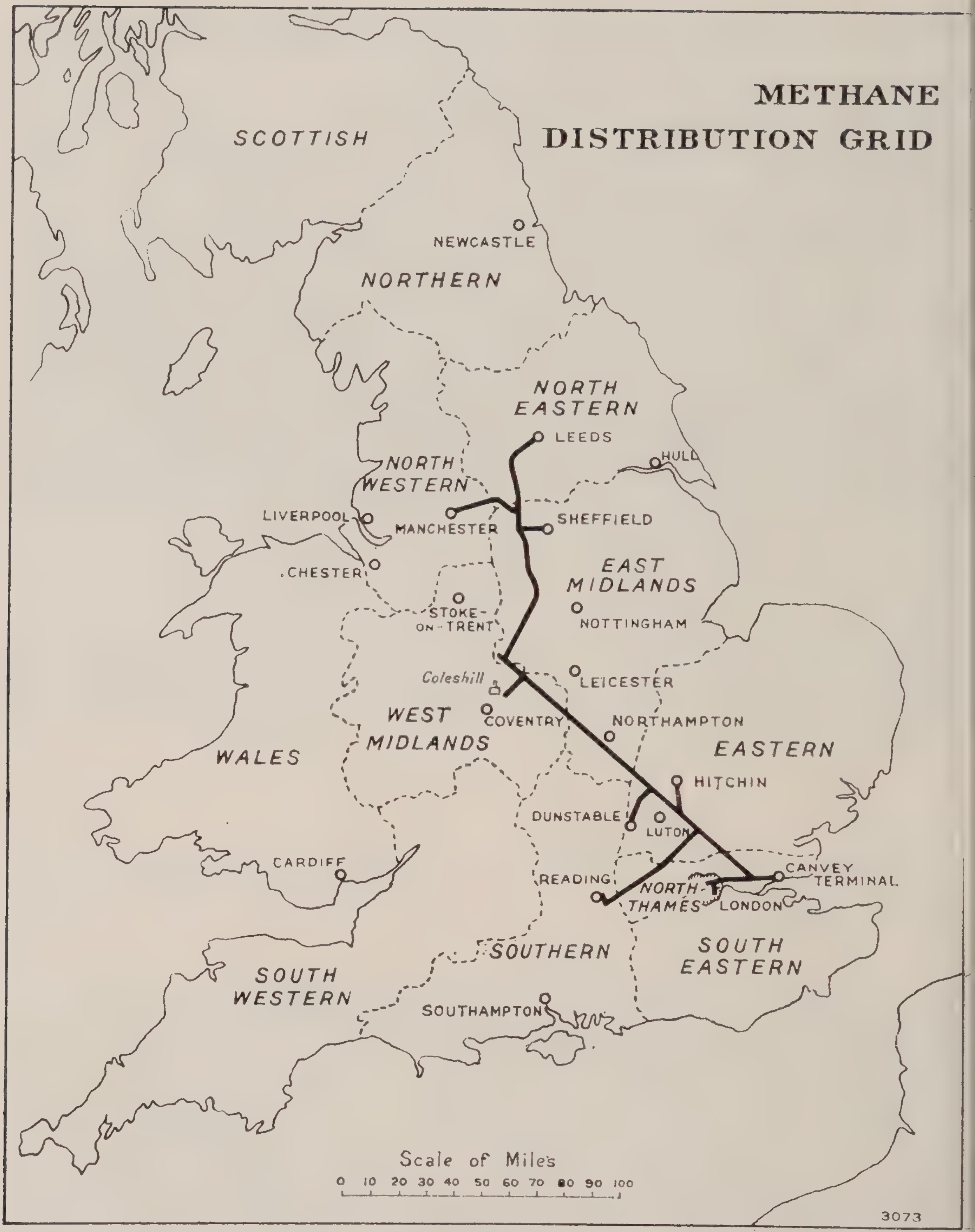

Fig. 7

requires the use of special equipment some of which has already been brought from other countries and is now working, and some of which is being built in this country at the present time in British shipyards.

These underwater drilling rigs are no mean enterprises, containing over 4,000 tons of steel, costing in the neighbourhood of £2½ million each, and being about 350 feet high (Fig. 9). If erected at Hyde Park Corner a typical rig would straddle the Hilton Hotel.

The activity taking place at the present time shows, by reason of the capital and engineering resources being spent, that many consider the potential prize worth having. If gas is found it must in the first place be offered by whoever finds it to the Gas Industry if it is to be used for normal fuel purposes. If one were prepared to venture an opinion in this unpredictable field, one might say it will take perhaps a minimum of five years and a maximum of ten years to develop. However, there is no doubt that if significant quantities are found they will have a revolutionary effect on the fuel industries of this country and, as a corollary a very large effect on clean air in this country.

However, the very real contribution which the Gas Industry is making to the increased availability of clean fuel is based on the known facts which have already been quoted, and not on the more problematical sources of fuel such as North Sea gas. A major discovery of this kind would, however, undoubtedly increase the use of gas even further.

Modern Domestic Gas Appliances and their Increased Efficiency

How have these technical advances affected the population as a whole?

What advantages have individual customers already experienced and

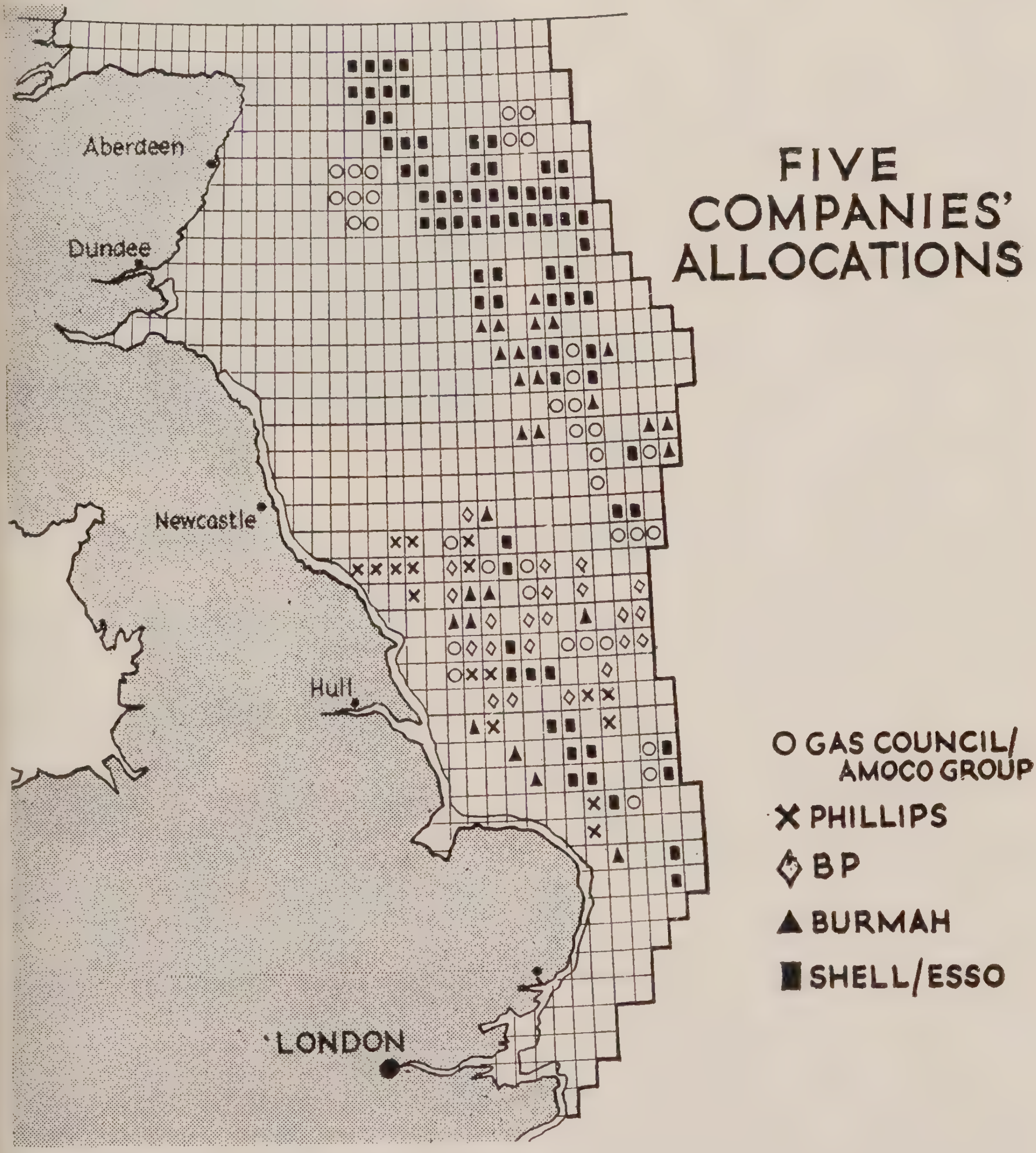

Fig. 8

will increasingly experience in the future?

Forecasting demand is a somewhat hazardous undertaking but can be assisted by historical hard facts. Gas sales are growing. The most reliable figure for the Industry as a whole is that the rate of growth at the present time is about eight per cent per annum, or—because the load is becoming more of a winter one due to the demand for more comfort and warmth—the winter peak load is increasing by about 16 per cent per annum.

A means of evening out this increasing load diversity will soon be available by storing gas under pressure in underground porous structures known as aquifers, sealed off by an overlying strata of impervious rock.

It is therefore not difficult to see that the Industry and its required production capacity is advancing at a very rapid rate, but at a reasonable capital cost. It is considered that the main reasons for this are—

(*a*) The introduction of a series of attractive well-styled convector/radiant room heaters which now have an efficiency of up to 75 per cent. These can be thermostatically controlled and being connected to a piped fuel are completely labour saving. They are thus becoming popular by self-recommendation of one customer to another.

(*b*) The development of a system of fan assisted warm air provided through ducts on a selective room basis by means of a gas/air heat interchange system. Such systems are becoming popular in new houses where the ducts can be designed as an integral part of the house when it is being built.

(*c*) The introduction of the small bore system of hot water supply to a series of radiators, in some cases assisted by a water pump. Here again a piped fuel, thermostatic control and the provision of both central heating and a full supply of domestic hot water from one boiler has made the system popular.

(*d*) The introduction of a promotional pricing tariff which has enabled customers to make use of these newer appliances with relatively higher consumptions at costs competitive with other fuels. There are the additional great advantages of using a clean fuel and having no storage problems.

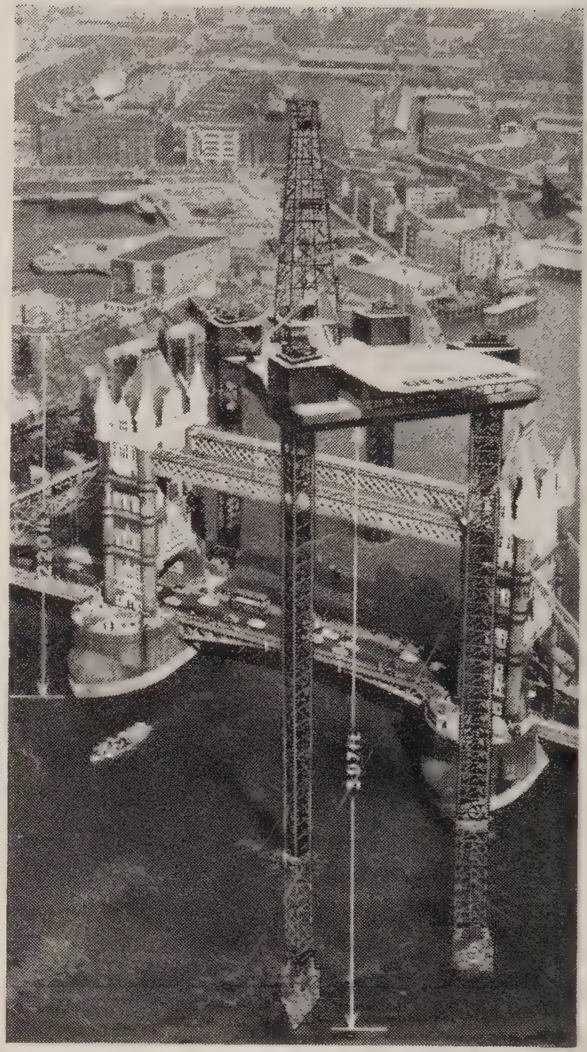

Fig. 9

The price tariffs available throughout the Industry naturally differ, but if we take the prices which are current in this area (the South Eastern Gas Board) a first class fuel service can be obtained by installing a gas room heater at a cost which is comparable with all other fuels. The sharp reduction in the costs of such a system since 1954/55 is due to the introduction of the special two-part tariff method of

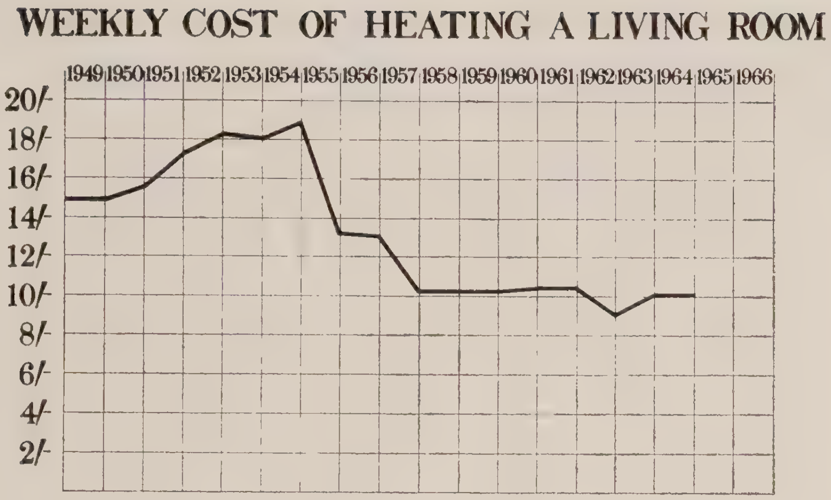

Fig. 10

charge. Fig. 10 illustrates this point.

In the same way it can be shown that taking the capital cost of gas central heating amortized over a seven-year period, plus the running costs based on the most economical method of paying for the gas used, the differences in total cost with the cheapest alternatives are marginal.

The availability of a piped, clean, controllable fuel has recommended itself to the public and as a result the increase in demand for gas has been dramatic. Fig. 11 shows the increase in sales over the country as a whole of gas room heaters and warm air and hot water systems of gas central heating over the last six years. The figure of nearly 1,000,000 room heaters sold in 1964/65 was 24 per cent greater than the previous year. When it is considered that there are about 17 million householders in the country at the present time, the contribution which this one type of appliance alone is making to clean air is quite remarkable, particularly as its growth appears to be continuing at this high rate. The same is true of gas warm air and hot water whole-house heating systems.

Perhaps the most significant figure is the increase in consumption per domestic consumer over the last few years. This trend as it relates to the South Eastern Gas Board is illustrated in Fig. 12 and is almost certain to continue.

Reference has already been made to the use of natural gas in the United States of America. It first began to be marketed in significant quantities in the eastern sea-board States in 1950, but since then due to the availability and the growth in the home heating load the total sales of gas in 1963 had grown in the New England States by nearly 300 per cent, in New Jersey by the same amount, and in New York by 150 per cent. In approximately the same period the relative costs of the main primary heating fuels have favoured gas, as can be seen from Table 1 quoted by Mr. Branson the President of the Institution of Gas Engineers in his Presidential Address in May of this year. Such changes could well occur in this country in the future.

One of the further advantages of a gas room heater is that it ventilates the room in which it is is installed and thus makes a contribution to the clean air in the home itself, making sure that vitiated atmospheres are not suffered by the occupants.

To ensure these air changes proper flues are necessary when continuously burning gas appliances such as room heaters are in use. There have been some difficulties in designing such flues, particularly in new multi-storied blocks of flats where the installation of a separate flue for each appliance might be prohibitive in cost.

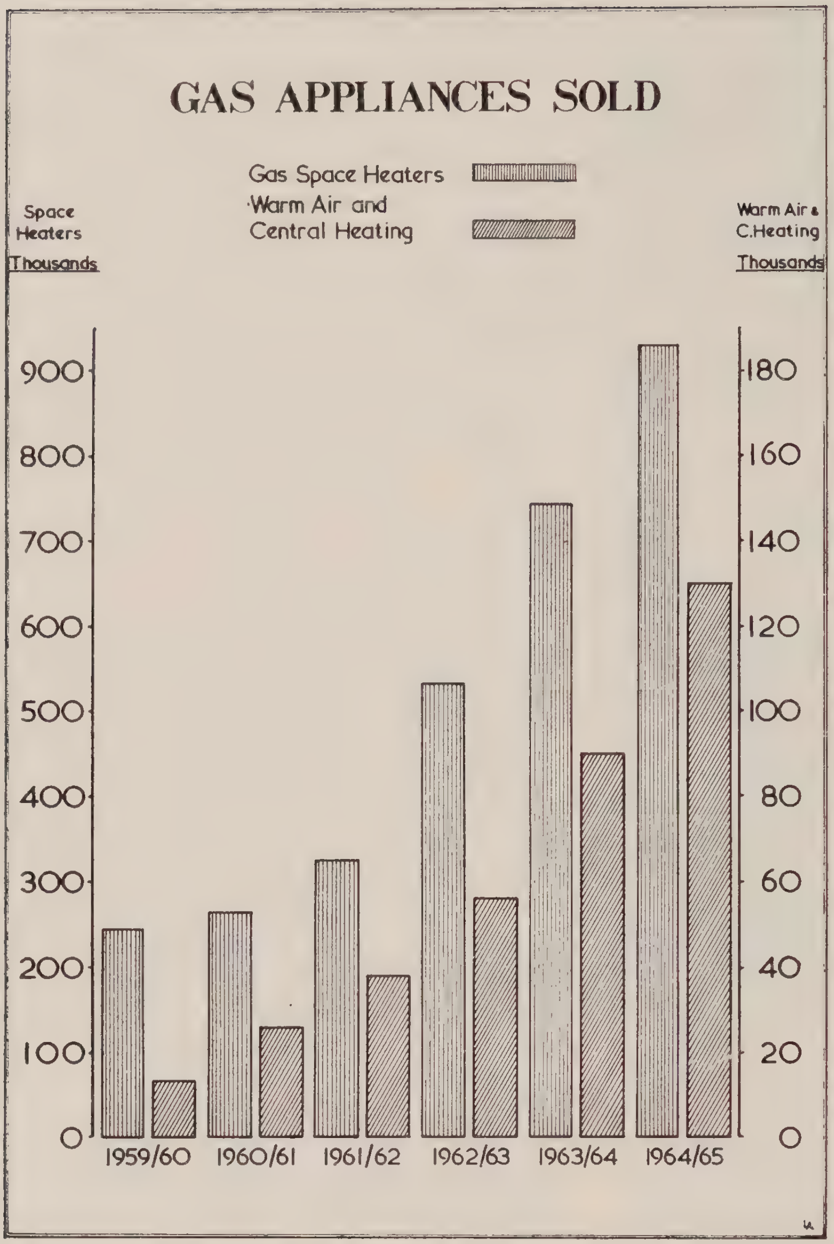
GAS APPLIANCES SOLD
Gas Space Heaters
Warm Air and Central Heating
Space Heaters Thousands
Warm Air & C.Heating Thousands
900
800
700
600
500
400
300
200
100
0
180
160
140
120
100
80
60
40
20
0
1959/60
1960/61
1961/62
1962/63
1963/64
1964/65

Fig. 11

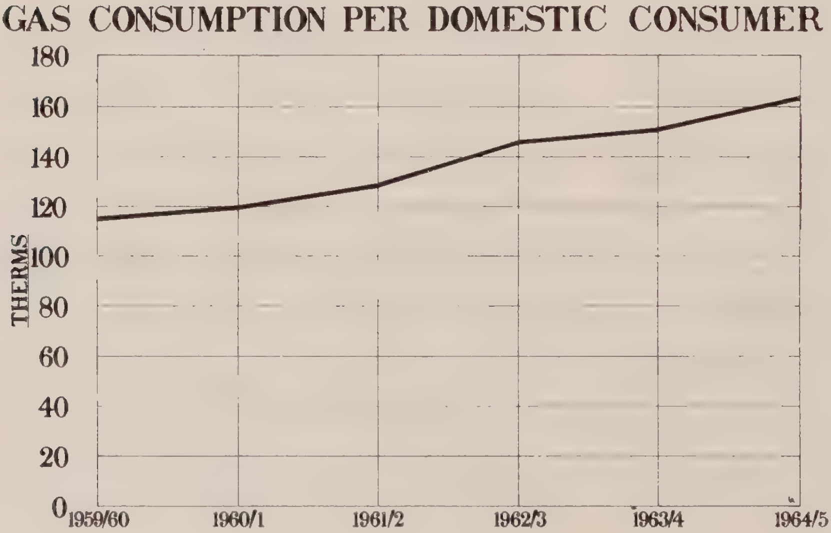
GAS CONSUMPTION PER DOMESTIC CONSUMER
THERMS
180
160
140
120
100
80
60
40
20
0
1959/60
1960/1
1961/2
1962/3
1963/4
1964/5

Fig. 12

Advances have been made to overcome these difficulties by the invention of a single flue to which a great number of gas appliances can be connected; the most well-known of these is the Seduct which is being used in multi-storied blocks throughout the country. A further advancement in design is the use of the balanced flue, which means that each gas appliance has its combustion chamber sealed from the room itself, being vented to an outside wall through a specially designed flue terminal.

Your Society is much to be congratulated on the ceaseless propaganda it has sponsored for cleaner air in this country and the success in the establishment of clean air zones. The grant scheme has naturally accelerated the changeover to cleaner fuels, but there is evidence that even without this incentive there is a considerable natural desire to make the change.

You may like to have confirmation of this trend from unsolicited evidence. First from a report of a Chief Public Health Inspector to a number of interested Authorities, including the South Eastern Gas Board:

> "Local inquiries have already indicated the marked preference for gas over both oil and electricity, where people no longer desire solid fuel. (This may to some extent be due to the fact that the installation of gas fires is the easiest course for occupiers of rented houses.)"

Secondly, a letter from the Medical Officer of a Greater London Borough.

> "From a survey of the area it appears that more than half of the dwellings have appliances capable of burning solid smokeless fuel, or use other forms of smokeless heating, although it is not known what proportion of the former do in fact burn smokeless fuels. As an estimate, it is considered that a maximum some 750 tons of smokeless fuels would be required annually to enable those householders who do not already burn smokeless fuels on those appliances to do so.
>
> "There are about 1,000 fires needing conversion to smokeless heating and a further 700 where ignition is required. Given free choice, the number wishing to convert to open fires is considered to be negligible, but a further 200 tons of solid smokeless fuel should be allowed to cover this.
>
> From a study of the area it is thought probable that more than three-quarters of the occupiers would wish to convert to gas fires, the remainder being probably equally divided between electric storage heaters and closed stoves."

TABLE 1—HEATING COSTS—U.S.A.

Fuel	Relative Cost (Gas = 100)	
	1950	1962
Boston		
Anthracite	68	97
Fuel Oil	76	106
Gas	100	100
New York		
Anthracite	74	106
Fuel Oil	86	128
Gas	100	100
Philadelphia		
Anthracite	80	97
Fuel Oil	99	126
Gas	100	100

These are unsolicited, objective, but naturally anonymous views which have lately been expressed. The great increase in sales of gas heating apparatus of various kinds, which has already been mentioned, supports these views. This does not, however, mean that the Industry has not still got a tremendous stake in the sphere of cooking and water heating in the home.

In conclusion, may I say that it is the customer who has the ultimate choice. As long as he has a free choice, and I emphasize this in the widest sense of the word, we believe that we have an ever increasing part to play in satisfying his increasing needs within the context of an even cleaner atmosphere.

SOLID FUEL

with Particular Reference to District Heating

by

*Dr. Wm. Reid, C.B.E., Ph.D.**

ABSTRACT

The paper shows the direction in which the Solid Fuel Industry is meeting the modern requirements of greater comfort at low cost, more efficient combustion and, therefore, a cleaner atmosphere. In this context the Industry has developed smokeless fuels and is increasing productivity of these to meet the rising demand. It has collaborated with the Appliance Manufacturers to produce new attractive, efficient and as near as possible automatic appliances.

Perhaps the most recent important development is in the direction of district heating. The paper describes in some detail the first comprehensive district heating scheme to serve multi-storey residential flats, the town's centre and cultural and educational facilities as well as adjacent light industry.

1. All fuel industries are in effect seeking to provide the general public with greater comfort in the home at as low a cost as possible. It would be generally agreed that standards of comfort or warmth in the home have been much lower in this country than in most of Western Europe and America. Changing ways of life, and a more affluent society are combining to make us generally demand higher standards of heating in our homes.

From the point of view of this Society, it is fortunate that greater comfort at low cost, means in the case of solid fuel, more efficient combustion—which when achieved, means clean air and smokeless combustion.

2. The solid fuel industry is meeting these modern requirements in three ways—

(*a*) The production of adequate supplies of smokeless fuels;

(*b*) Stimulating the design and production of new, efficient and as near as possible, automatic appliances.

(*c*) District Heating.

Though it is the latter (*c*) which this paper is to deal with in greater detail the subject would be out of proper perspective without some reference to (*a*) and (*b*).

(*a*) *Smokeless Fuels*

Traditional solid smokeless fuels are too well known to this Society to need any description.

The Coal Board's efforts to produce a premium smokeless fuel for open fires are nearing fruition with the approaching commissioning of the Coventry plant, which will produce "Homefire".

In addition, several plants are either being commissioned, built or being planned in various parts of the Country to produce "Roomheat", a smokeless fuel intended particularly for use on roomheaters, but equally satisfactory on modern open fires.

Production will soon commence on Phurnacine, a product of South Wales, akin to Phurnacite in many respects.

These new fuels, together with the well established smokeless fuels—Sunbrite, Premium Gas cokes, Coalite, Rexco, and the like, will provide a varied and adequate answer to the demand for modern smokeless fuels, suitable for use on the greatly improved appliances now available to meet all needs of modern house warming.

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* Chairman, Northumberland and Durham Division, National Coal Board.

(*b*) *Appliances*

Here the aim has been to stimulate the production of appliances which, while providing smokelessly any standard of comfort desired, most economically, would at the same time satisfy modern ideas of amenity, in terms of design, appearance, cleanliness and labour saving. Though, as yet, only in a very few can the full benefits of the ease of operation offered by the switch and the tap be met—great progress has been made.

Such appliances as the behind glass fire—the roomheater—with high output back boiler, is answering the demand for additional warmth in all parts of the home, through small bore circulation to radiators, coupled with cleanliness and smokeless combustion. Further developments are on the way in this particular field.

The independent boiler has been developed to give much longer periods between refuelling, and modern hopper fed appliances are capable of burning 24 hours without attention. Ash handling methods are also greatly improved.

The underfloor draught open fire is well established—and has obvious advantages. A comparatively new refinement is the application of assisted draught by means of a small fan, to this type of fire, which makes them suitable for burning all smokeless fuels, including Sunbrite. These fires can be associated with high output back boilers from which domestic hot water requirements and radiators can be served.

An interesting development for the appropriate setting is the back to back boiler and roomheater.Where kitchen and living room are back to back, this appliance provides in the kitchen a free standing boiler to operate a central heating scheme and provide domestic hot water, together with a fire behind glass in the living room. This gives the amenity of a cosy fire without either fuelling or de-ashing in this room. This takes place in the kitchen via the hopper fed boiler.

A further development is the burning of bituminous singles smokelessly by means of the "Stokermatic". This appliance requires a coal storage bin preferably outside the house or with loading outside the house where coal can be delivered direct to bunker. There is a screw feed to the fire grate. This appliance will serve a central heating system and domestic hot water for the large and medium dwelling house. The only manual labour required of the householder is for ash removal.

3. This illustrates briefly some of the development work which is going on in respect of domestic solid fuels, but it is the fully automated system of district heating with which the remainder of this paper is concerned.

In its most simple terms the definition of District Heating is to provide heat to multiple units of buildings and/or premises from a central boiler house. The basic concept is not new; the Romans used ducts for the transference of heat in the form of hot water from a central point to various rooms and baths within a villa. Today hospitals and larger industrial undertakings, serving multiple buildings are, in fact, District Heating Schemes. The heating of blocks of flats is the same concept on a smaller scale but it is the wider concept of the heating of town centre developments and housing on a large scale with which this paper will deal. At the outset it must be stated that District Heating is synonymous with clean air. District Heating means bigger plant with automatic controls, better supervision, higher efficiencies in operation, with one boiler house heating a big area with no other chimneys and all this can only mean smokeless operation.

Why is District Heating only in its infancy in this country? District Heating schemes have been operating successfully in North America and many of the countries of north western Europe during the past 30 years or more. There are 275 towns with schemes in Denmark and over 350 in Germany. One of the main reasons for lack of interest in the past has been that domestic fuel in this country was extremely cheap and that before the war domestic help was fairly readily available. After the Second World War a number of schemes were installed in this country but with little success. This was due largely to mains corrosion and the fact that there were some difficulties in balancing the systems, particularly the heating of houses at the extremities of the system.

4. Renewed interest in District Heating in this country was aroused about two years ago when the National Coal Board set up a Design and Heating Study Group under the Chairmanship of Mr. A. Sheppard Fiddler, Architect to the City of Birmingham. The Group was established in consultation with the Royal Institute of British Architects, the Institution of Heating and Ventilating Engineers, the Building Research Board and the Coal Utilisation Council.

Increasing interest in District Heating is also closely related to our changing standards of living. Modern planning is tending towards greater mixed development. Blocks of flats are closely associated with shopping precincts and cultural and educational facilities. The fashion of separating completely residential development from industrial buildings is losing some ground. In the home the changing pattern of development, particularly high density multi-storey housing requires a new approach to the problem of heating. The change in the use of domestic premises in a society where the married woman is a vital part of the nation's labour force, together with the provision of a meals service in our schools, has resulted in a change in heating loads in the home, again necessitating a modification in the heating service required by householders. In the affluent society, service, which has always been important, becomes paramount. The customer will pay for the service he wants. District Heating provides such a service and the Billingham Scheme, which is the only fully operative town centre project in this country, will be used to illustrate the potential of the modern solid fuel fired district heating scheme.

5. The Development of Billingham

In the early 1920s Billingham was little more than a large village but with the growth of I.C.I. Billingham Division, the town prospered and grew. By 1947 the population had increased to over 25,000 and is now estimated to be nearly 35,000. Soon

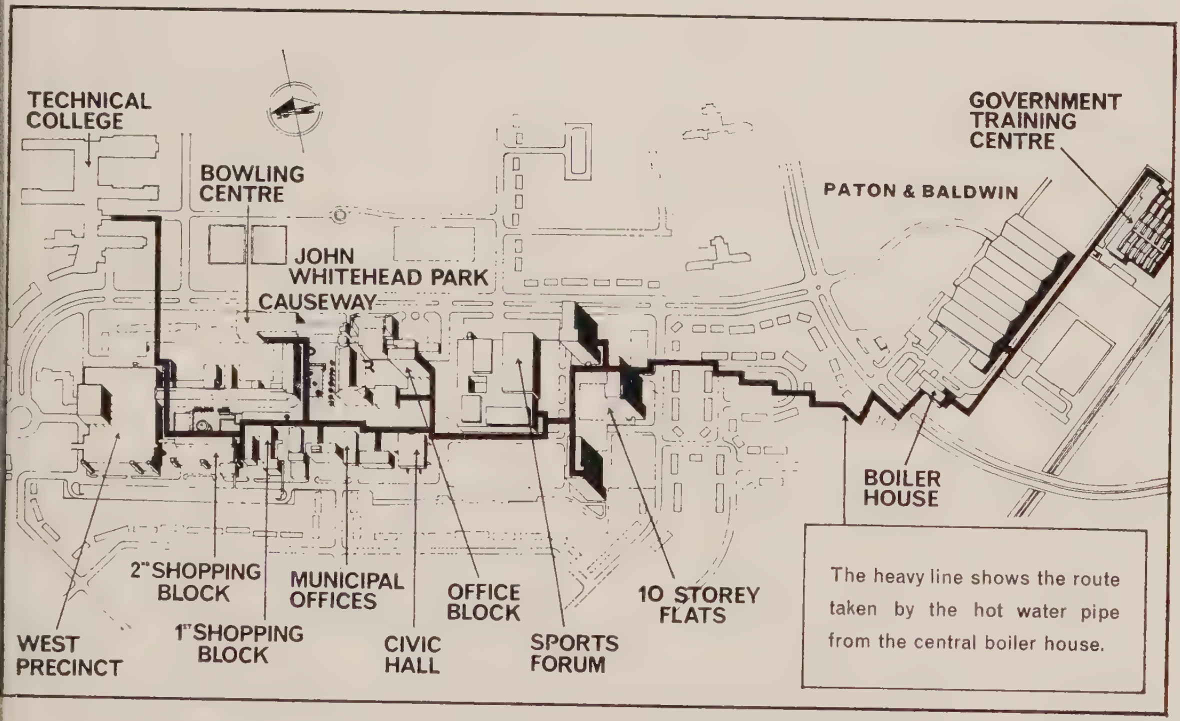

Fig. 1—Billingham Town centre, showing district heating distribution mains

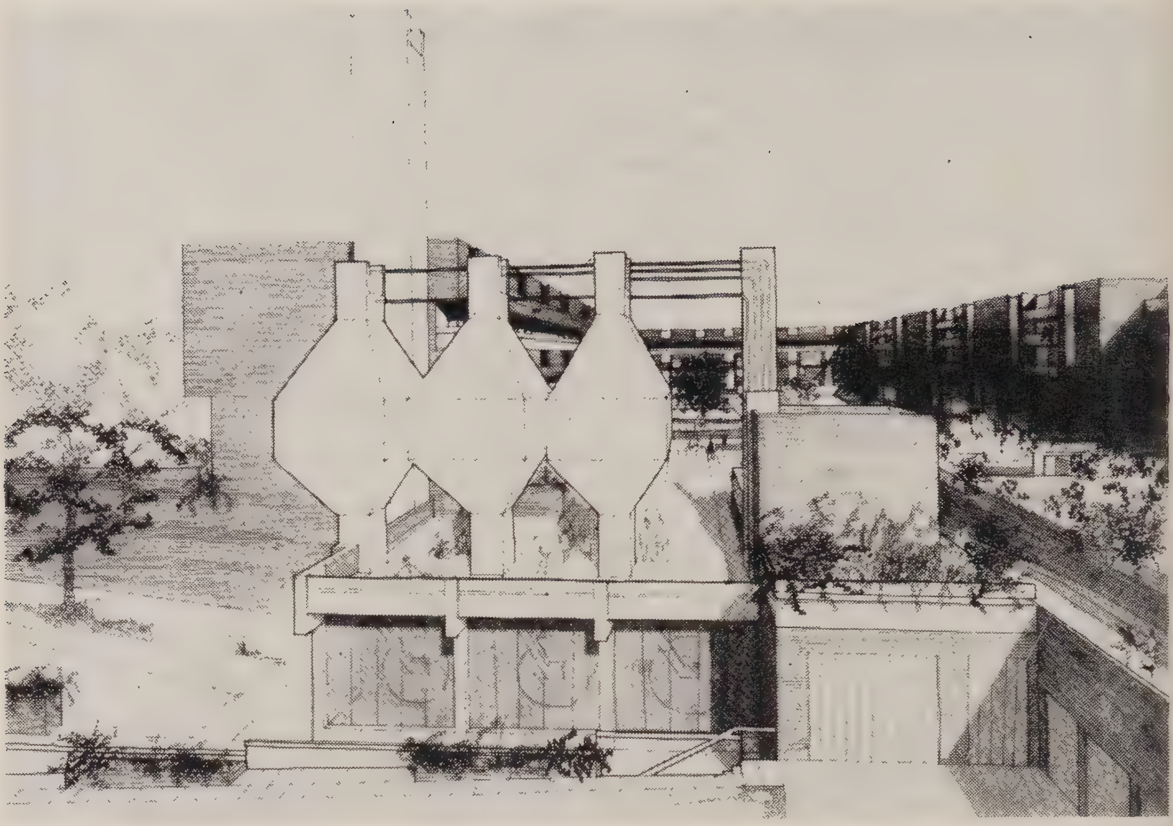

Fig. 2—Washington Urban District Council—proposed Boiler House

after the war when the existing town centre was still sited round the old Billingham Green, the Council made the bold decision to create a new town centre. They purchased the land, retained a local architect for planning and have been responsible for the whole development.

The town centre covers about 36 acres. The broad plan for a 5/7 year development can best be illustrated by reference to a plan (Figure 1). The development consists of traffic free shopping precincts with adequate free parking facilities (about 1,000 cars). There is a Civic Centre, Municipal and Crown Buildings, a first class residential hotel and bowling alley. The town centre residential area consists of 3 blocks of 10-storey flats each with 75 units consisting of one, two and three bedroom flats. It is the Council's intention to create a centre of cultural activity in the town centre and with this in view, a Sports Forum is under construction. This is an ambitious concept and will provide facilities for all indoor games, a swimming pool, an auditorium, an ice rink and full catering facilities. In addition, the Council reserved adequate land adjacent to the Town Centre for light industrial development. This new and enlightened approach to town development deserved a similar approach to the problem of its heat requirements.

First discussions on the potential of group heating were instituted with the Urban District Council in 1962. The National Coal Board retained Consultants to prepare a feasibility report. The problem was to heat the new town centre at highest efficiency, lowest tariff and within the requirements of the Clean Air Act. This was achieved and the Council finally accepted the scheme in mid-1963.

6. The Scheme

The town was already in the process of building and it was necessary to provide heat by the beginning of the 1963/64 heating season. Temporary coke boilers were installed to meet various loads in the early development. In less than 5 months from Paton and Baldwins' deciding to link up with the scheme for the requirements of their new factory, a 5 million Btu./hr.

boiler was ordered, a temporary boiler house erected and heat supplied to the new building for drying out in December, 1963.

The main scheme was designed to meet the town development programme. The Coal Board agreed to build the boiler house, install and operate the plant, whilst the Council were to install and maintain the whole of the distribution system.

7. The Boiler Plant

The plant is designed to meet peak load conditions, annual heat take is only vital in assessing the viability of the scheme.

In order to meet Clean Air requirements, the chimney has to be 120 ft. It is always policy to site the boiler house as near to the main load as possible and the original intention was to place it in the town centre but when the potential of the light industrial site was assessed it was decided to build there (see Figure 1, Boiler House). The siting in a town centre is more difficult but good design can overcome this. The architect for a multi-storey flat development at Washington, County Durham, has made a feature of the boiler house. The flat roof is to be a children's playground and the feed bunkers an architectural feature of the development (Figure 2).

The estimated maximum load at Billingham is about 41 million Btu./hr. The plant was planned for 3 16 million Btu./hr. boilers but load factors are important, in fact vital, and in order to obtain flexibility to meet low load conditions, a 5 million Btu./hr. boiler was substituted for one of the 16 million units. In addition, the grate of one of the 16 million units has been modified to operate at 10 million when required. This gives vital operational flexibility.

The boilers are G.W.B. Powermasters (see Figure 3, the boiler house). Maximum automation has been incorporated so that the plant is operated by two men only. They use the operating flexibility to maintain a clean chimney stack and high efficiency which is in excess of 80 per cent.

The coal feed consists of overhead bunkers (see Figure 3), automatic feed to boilers (see Figure 3). Coal delivery is by pneumatic delivery vehicles which feed direct into the overhead bunkers by stand pipes—height 45 feet with farthest bunker 75 feet horizontal distance from delivery point.

The delivery point is in an enclosed bay. Ash disposal is also from the same bay. Grit arrestors on boiler guarantee less than 0·1 grains/cu.ft. all of which eliminates dust nuisance and helps to ensure Clean Air.

8. The Distribution System

The mains are a simple flow and return 8″ diameter pipe reducing to 4″ at extremities. There are nearly 2 miles of mains in total.

Two important features of distribution mains are pipe protection to minimize erosion and insulation to minimize heat losses on which comment is made later. At Billingham the pipes are slung in ducts to keep clear of water and are well insulated.

The heat is in the form of medium pressure hot water which is produced in the Board's boiler house then pumped into the Council's distribution mains at 300°F. The return temperature is about 200°F.

For each block of buildings there is a heat exchanger in the form of a calorifier which heats the water in the secondary system to 170°F. this being the temperature of domestic hot water. The return water in the secondary main is at about 140°F. In each block there is a normal domestic circulation system which enables complete flexibility on method of heating, conventional radiators, warm air systems or even air conditioning.

9. Tariff

The capital cost of a scheme of this type is high—boiler house, the plant, the mains and heating units—but the operating cost is low.

The price to the consumer is generally competitive; at Billingham

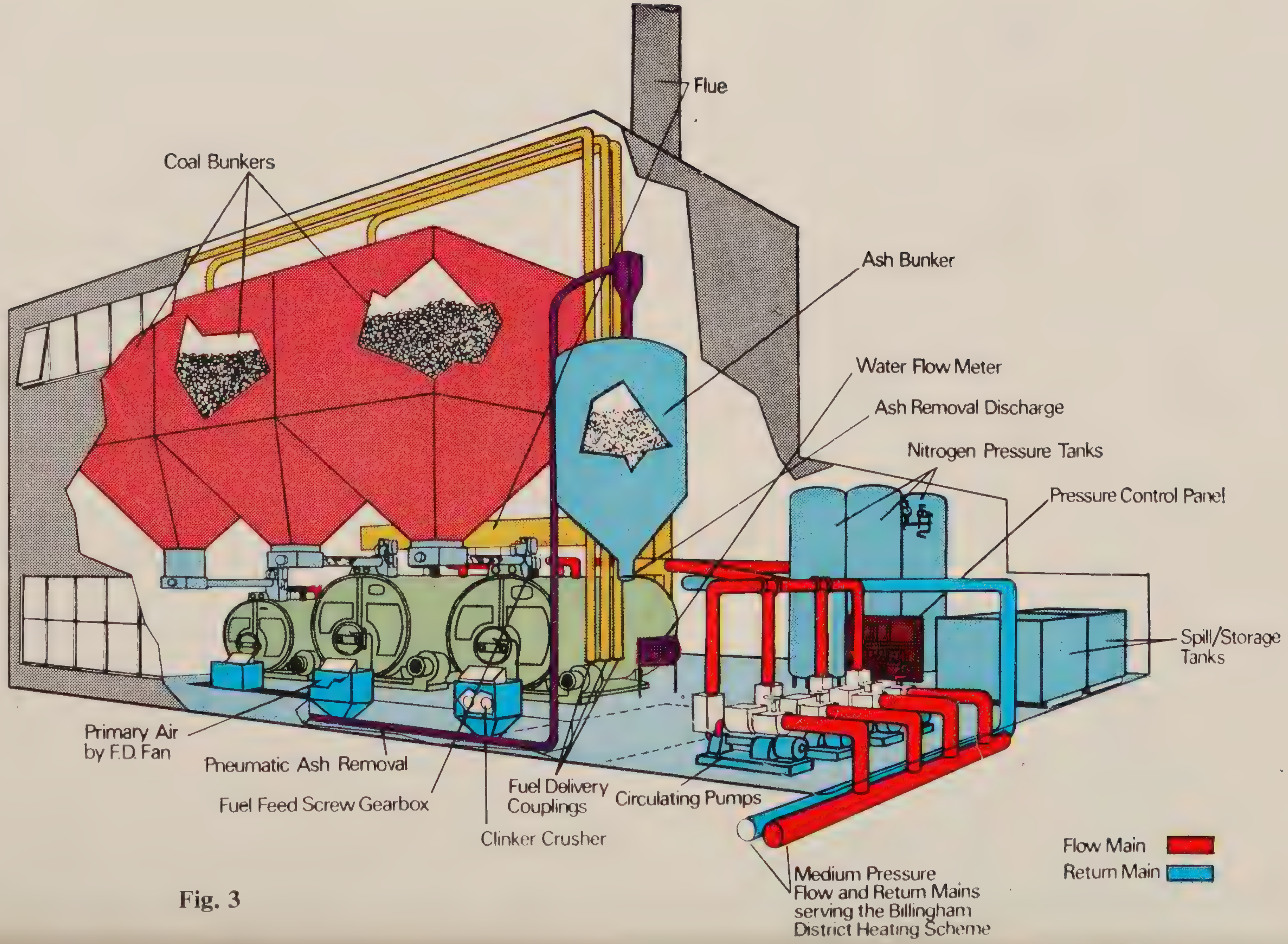
Flue
Coal Bunkers
Ash Bunker
Water Flow Meter
Ash Removal Discharge
Nitrogen Pressure Tanks
Pressure Control Panel
Spill/Storage Tanks
Primary Air by F.D. Fan
Pneumatic Ash Removal
Fuel Feed Screw Gearbox
Fuel Delivery Couplings
Circulating Pumps
Clinker Crusher
Flow Main 🟥
Return Main 🟦
Medium Pressure Flow and Return Mains serving the Billingham District Heating Scheme

Fig. 3

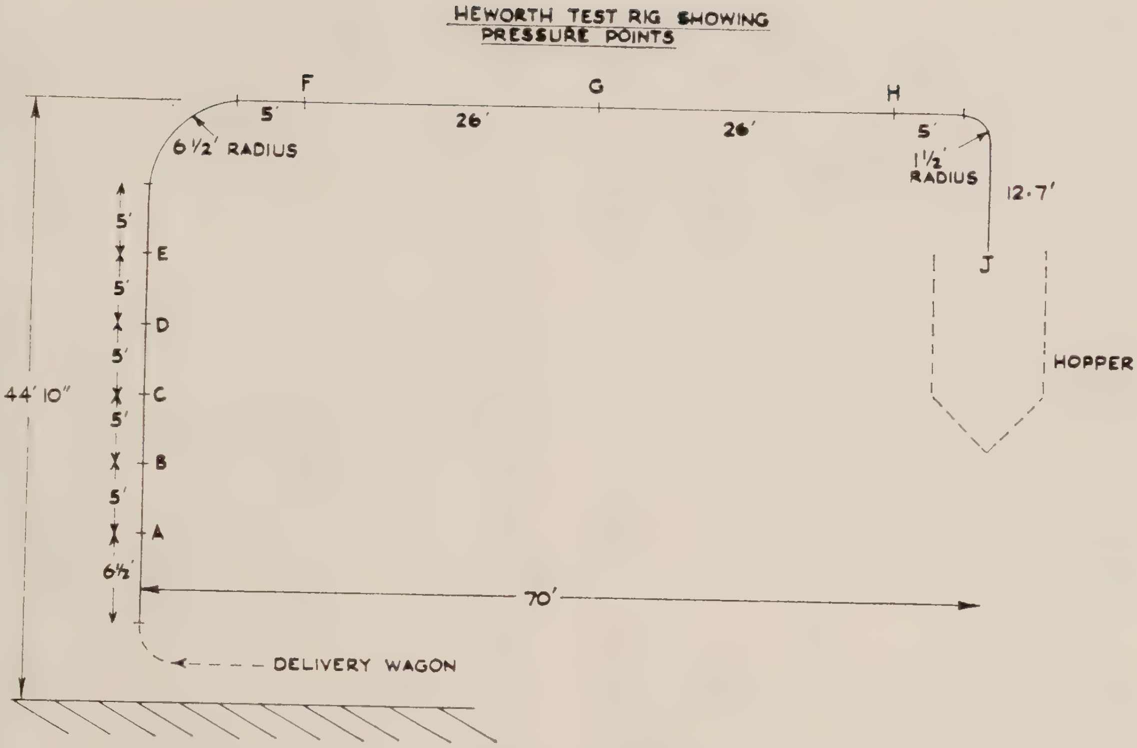

Fig. 4—Heworth Test Rig for Pneumatic Delivery

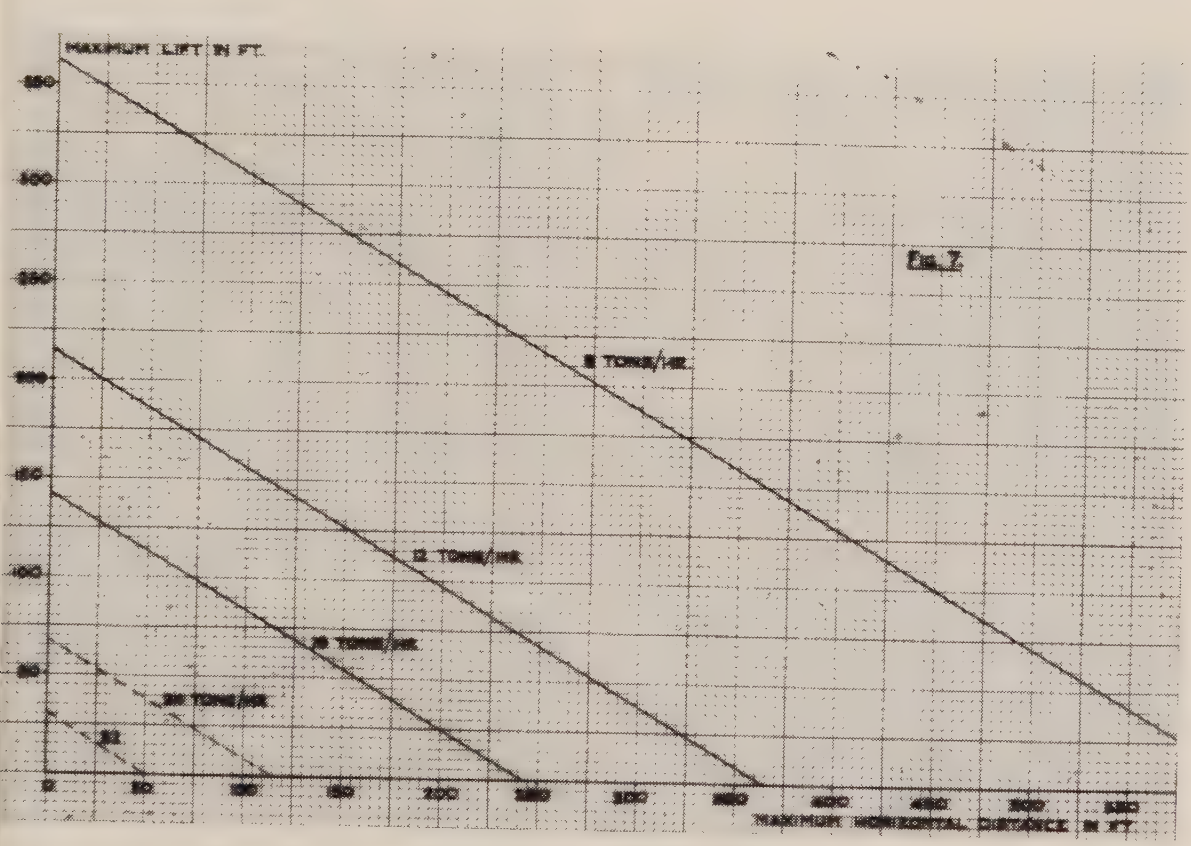

Fig. 5—Results from above

for example, heat is supplied at about 1s. 3d. per therm but this must vary according to heat load etc. It must be appreciated that this is effective heat at the radiator whereas individual systems, free-standing boilers, gas fires, etc., operate at something like 60/75 per cent efficiency.

The heat is metered firstly at the exit to the boiler house where the Board sell to the Council, then at each main block of buildings there are meters and small meters, to record consumption in individual premises.

The Urban District Council are responsible for all invoicing and cash collection.

10. Research

The Board are pioneers in this work and there is much to learn, on the other hand much valuable experience has been gained. It has been found that once a scheme of this kind is off the drawing board, industry becomes interested in specific problems. They are willing to carry out research where there is the possibility of commercial gain.

The Board have also undertaken some basic research and much valuable work is being done by their Scientific Department.

(*a*) *Pneumatic Delivery*

A test rig was erected at Heworth Colliery (Figures 4 and 5), the results of a number of tests were plotted enabling calculations to be made of the delivery time for various vertical and horizontal flows. This is vital information in the planning stage for any new solid fuel fired boiler plant incorporating pneumatic delivery.

(*b*) *Meters*

It was foreseen that metering might be a major problem in district heating. The large meters required for the mains metering are quite expensive, but are accurate. The real problem is in the metering of individual premises. The small meter must be cheap but at low cost accuracy is doubtful. It is possible, of course, to use small meters primarily as apportioning devices, i.e. to apportion between householders the flow of heat through the main meter into the block of flats. The Board feel, however, that it is vital to the success of district heating in this Country to charge an individual with some accuracy for the heat he is using.

The Continent has been combed for a suitable meter and an adaption of a Swiss-made water flow meter was accepted as the best available. Scientific Department set up a test rig (Figure 6), where they have been calibrating each meter prior to installation (Figure 7). This meter had limitations in that an adjusting factor had to be applied to each reading before submitting the invoice and individuals were unable to read their meters. A bigger Dutch meter was then adapted for use at Billingham. This is more costly but gives improved results (Figure 8) and these have been installed in the 2nd and 3rd blocks of flats.

Industry has shown interest and much development work on small meters is going on. Results are encouraging and this country may well soon lead the world in the design and accuracy of small meters.

(*c*) *Pipe Protection*

Early group heating schemes in this country experienced much trouble due to pipe erosion. The common system on the continent is to lay pipes in cellular concrete then back fill, but at Billingham pipes are slung in ducts to keep clear of water and minimize erosion. This also enables easy access to the pipes but costs more than back filling.

Insulation is vital as heat losses affect tariff. Losses are calculated at about 10 per cent. but can be much higher under low load conditions. Any saving in heat losses is well worth making.

Again Scientific Department are working on these problems with a firm of national repute. New materials are being tested under the most severe conditions. Success may enable the back filling method to be used,

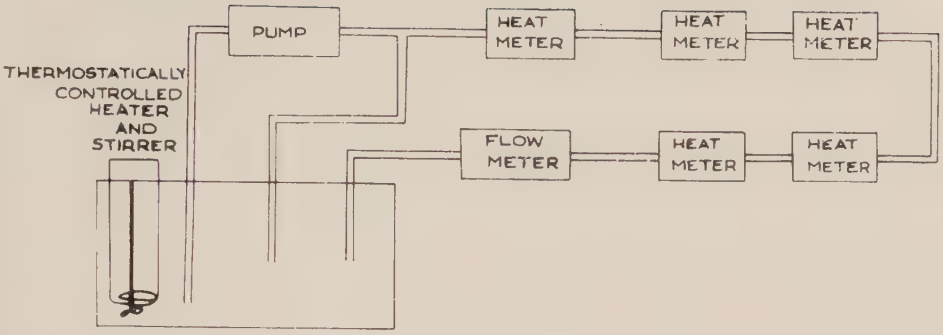

Fig. 6—Test Rig for calibration of small heat meters

entailing lower capital costs with consequent lower tariffs.

11. Future

What of the future? This is a new way of selling heat produced from solid fuel; it is the coal industry's answer to the amenity conscious public. Abundant heat is obtained at the turn of a valve, hot water at the turn of a tap—no gas jets, no matches, no paper, no sticks, no fire hazard, no effort.

There must be a period of development but there is a growing interest amongst architects, local authorities and the like, in the potential of District Heating. The Buchanan report forecasts overcrowded roads and traffic difficulties but a system of common duct services will ease this problem by

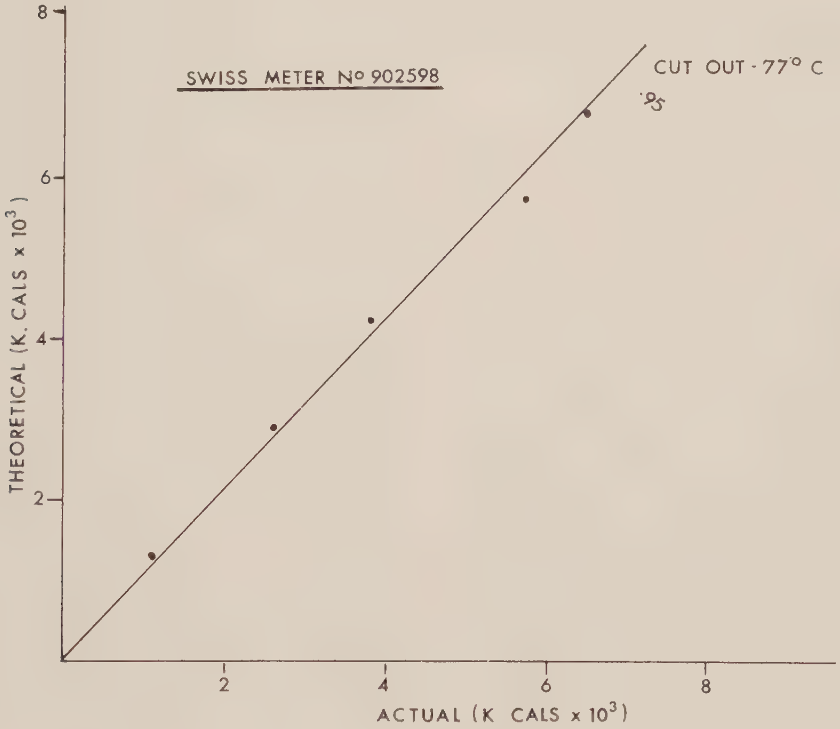

Fig. 7—Testing of heat meters

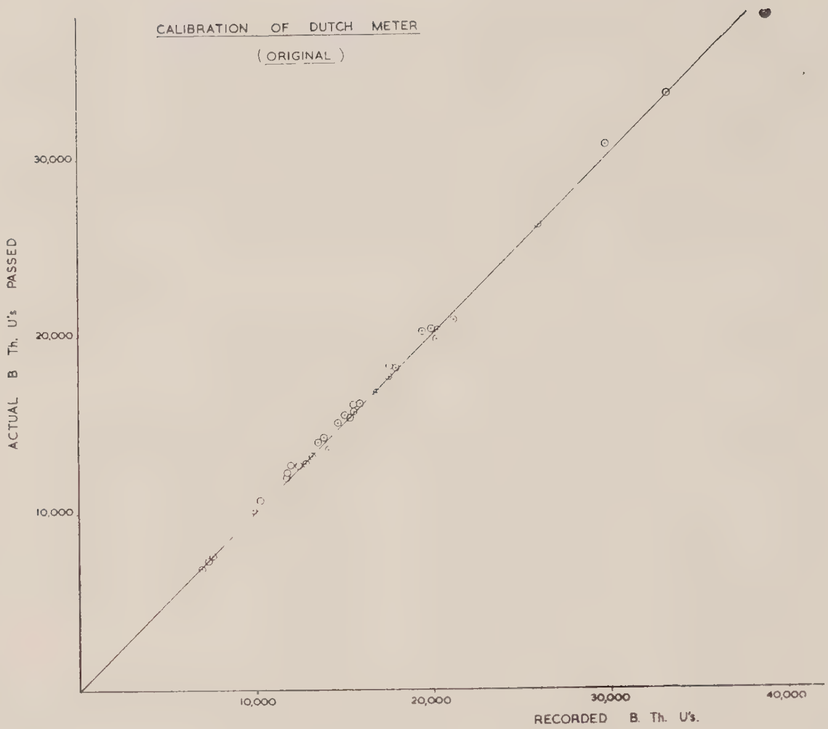

Fig. 8—Testing of heat meters

eliminating the need to continually take up roads to deal with maintenance and development of town services. Planning Consultants are already examining this problem and many local authorities support the idea.

With our changing habits and improving standards of living, we are all looking for the best amenities. Efficient District Heating systems will be the basis of much of the heating of towns and dwellings in the future. The country's basic energy industry, coal, is in the forefront of this modern, efficient means of improving our heating standards.

OFF-PEAK ELECTRICITY

*by C. T. Melling, C.B.E., M.Sc.Tech., M.I.E.E., M.I.Mech.E., F.Inst.F.**

ABSTRACT

The paper reviews the different fuels used in the home, and discusses the heat-comfort required by the occupants of room. The three general types of heating using off-peak electricity are floor-warming, Unit Plan heating, and warm air heating, and these are discussed in some detail. The paper concludes by emphasizing that the day-time or afternoon off-peak boost for storage heaters will continue to be available.

THE purpose of a heating system in a room or building is to give heat-comfort to the occupants and, to be satisfactory, it should be both economical and adaptable to heating needs. In some houses it may be desirable to have all the rooms maintained at constant temperatures, but in most houses this is not required; some rooms may be in regular use but others may require full heating for only an hour or two each day. In some houses, full central heating may be desirable or, for special reasons, even necessary, but in the majority of houses full central heating is unnecessary and frequently extravagant, partial central heating being more appropriate to the occupants' requirements — partial in the sense of being substantial background heating of some or all rooms, with facilities for "topping up" when required. Either full or partial central heating can be achieved by electric heating and off-peak supplies are providing the substantial background heating in an increasing measure.

Before examining the various types of electric heating and their use in an adaptable and economical heating system, let us consider the use of all the different fuels used in domestic premises.

TABLE I

Ownership of space heating appliances in some part of the house for England and Wales

(*June*, 1964, *except solid fuel and oil, June*, 1963)

	Percentage of households
Solid fuel.. ..	94
Electric	73
Paraffin	34
Gas	16
Oil	1

Sources: AGB Home Audit of 50,000 *homes and the* 1963 *Domestic Heating Survey of* 13,000 *homes commissioned by the Electricity Council with Social Surveys (Gallup Poll) Ltd.*

Table I gives a general indication, based on large-scale market research survey, of the installation of various types of fuel-using appliances for comfort-heating in the home. Many households have provision for using more than one type of fuel in one part or another of their home. In living rooms, it is likely that more than one fuel is used, e.g. open fire in winter, but electric fire at other times of year when evenings are chilly. In bedrooms, on the other hand, although in 47 per cent of homes there is a grate for burning solid fuel in one or more bedrooms, the majority of these are not used, the usual alternative being an electric fire.

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* Deputy Chairman, the Electricity Council.

The present position of central heating is indicated in Table II, showing all types of central heating, whether full or partial. The majority of oil and gas installations are for full central heating, while most of the solid fuel and electric installations are for partial central heating. The electric installations which provide partial central heating are designed to give a satisfactory background temperature, supplemented as desired by an electric fire. Additional electric central heating can be added, with little trouble or disturbance, and the householder can decide by his own experience, and without financial risk, how much central heating he desires to have. The use of electric fires for supplementary heating is not confined to electric central heating. It is known that some other forms of central heating systems have been installed with the advice to the purchasers that, if the installation should prove inadequate in very cold weather, it could easily be "topped up" by using an electric fire!

In addition to the various types of central heating, many other room heaters were bought during 1964—some to replace existing heaters, others to provide additional heat-comfort. During 1964, almost 2 million electric fires, some 300,000 electric fan heaters, and 400,000 electric convectors or electric oil-filled radiators were bought, making a total of over 2,600,000 electric room heaters bought during the year. There were also 700,000 gas and 300,000 oil room heaters bought during the year in addition to solid fuel heaters.

Before dealing with the various types of heating by electricity, let us look further at the heat-comfort required by the occupants of a room. Heat-comfort is a complex requirement, involving a correct combination of temperatures of the air, floor, walls, ceiling, and contents of a room, under reasonable conditions of humidity and ventilation. In general, satisfactory heat-comfort is obtained with a room temperature of 65°F—68°F, i.e. air temperature and mean radiant temperature of surroundings, with a relative humidity of about 50 per cent and ventilation, of a room which is not crowded, of one or rather more air changes per hour. For small temperature differences, heat-comfort can be maintained with a lower mean radiant temperature of the surroundings and a corresponding higher air temperature, e.g. switching on an electric convector heater in a room which is not warm enough for occupation. Conversely, a lower air temperature requires a high mean radiant temperature of surroundings, e.g. switching on an electric fire to bring up the heat-comfort conditions to the required level.

There are many qualifications to add to these broad generalizations as heat-comfort depends also on the activities of the occupants of a room; sitting quietly watching television a young adult generates about one-fifth of a kW or less, but this is increased to about one-half of a kW if that

TABLE II

Ownership of central heating installations

(14 *per cent of households in Great Britain*)

	Total at December, 1964		*Added during* 1964	
	No.	*Per cent*	*No.*	*Per cent*
Solid fuel ..	1,295,000	58	190,000	42
Electric	325,000	15	145,000	31
Gas	295,000	13	90,000	20
Oil	195,000	9	25,000	6
Communal ..	115,000	5	5,000	1
	2,225,000	100	455,000	100

Source: AGB Home Audit, by whose kind permission it is reproduced here.

adult is engaged in the more vigorous forms of modern dancing! It depends also on the age, clothing, and health of the occupants. Elderly people, invalids, and those suffering from shock clearly require higher room temperatures than the young and vigorous. Heat-comfort may be affected to a small degree by minor psychological factors such as depressing news, foggy and inclement weather, or gloomy surroundings. Under these circumstances, the feeling of comfort may be improved by the appearance of a "cosy" fire—solid fuel, gas, oil, or electricity—or by an electric lighting effect such as an imitation coal or log fire, without using the heating element.

Heat-comfort varies also with the standard of heating to which the occupants of a room have become accustomed, e.g. visitors from America are frequently astonished by the traditional British open fire which in this country is considered to be a satisfactory antidote to the prevalent winter conditions, while those who stay in New York in January have to remember that British indoor clothing may be inappropriately warm.

A further qualification to the above generalizations on heat-comfort is the desirability of a temperature gradient to provide that the temperature at floor level is between 5° and 10° higher than that at head level—"warm feet and cool head".

All these ingredients of heat-comfort emphasise the need for a heating system which is adaptable to the particular needs of those living in or visiting a house. A good heating system is not only the one which provides the correct number of Btu's but one which provides the heat which the occupants want, when and where they want it.

Electric central heating using off-peak tariffs for cheap electricity is of three general types—floor warming, Unit Plan heating and warm air heating. Electric floor warming, although introduced only about forty years ago, is a modern variant of the under-floor heating used in the more luxurious villas of Roman times. Electric floor warming can be applied to most types of concrete floor, whether suspended or in contact with the ground, and its development is complementary to modern building practice. In most structures, it provides heat-comfort conditions with lower air temperature than other systems relying on convected heat; it has the desirable temperature gradient between floor and head level; the feeling of fresher air and the freedom from draughts are major factors contributing to the very high degree of user satisfaction.

Typical loadings for a large block of flats are 13—15 watts per sq. ft. in living rooms on the ground floor, 12—14 watts per sq. ft. on intermediate floors, and 14—16 watts on the top floor. Where floor warming is used in bedrooms, the loadings are usually 75 per cent of these figures. For individual houses, somewhat higher loadings are used to off-set the greater heat loss, but these should not exceed 18 watts per sq. ft. The maximum overall floor temperature for which installations are designed is about 77°F which corresponds to the maximum suggested after investigations made by the Medical Research Council.

Electric floor warming installations are supplied on off-peak tariffs controlled by time switch, but the hours of supply may be reduced, as required, by means of a hand-operated switch and simple air thermostat in each main room, controlling the input of the electric warming cables. A refinement is the use of thermostatic control system taking account of external weather conditions, and many of these are now being used to advantage. The efficiency and economy of electric floor warming has been confirmed by the Heating and Ventilating Research Association in their Report "The Heating of Buildings by off-peak Electricity Supplies", May, 1961.

Many users find this form of central heating to be all they require, but it may be augmented, at the desire of the occupants of a room, by a suitable lighting effect such as an electric coal or log fire with or without a heating element. Electric floor warming is now used in about 160,000 domestic premises in Great Britain.

During the last few years, research investigations have been made into improved forms of floor warming installation—cables, concrete mixes, and control. In consequence, improved, reliable techniques have been introduced. In the unlikely circumstances of a fault occurring, its location can be ascertained with accuracy to within an inch or so.

The Unit Plan heater, the second form of electric central heating, has a heating element in heat storage material such as concrete blocks in a steel container with suitable heat insulation. Here again, the heating principle is an old one, i.e. a heated brick wrapped in a rug or blanket as the early form of bed warmer or foot warmer. For many years there have been experimental models of electric storage heaters, but it was only about 1951 that they became available for commercial use in this country, on the initiative of one of the Area Electricity Boards. Although they had a wide acceptance for offices and shops, they were not at first available for domestic use owing to Purchase Tax difficulties, and it was not until the Autumn of 1961 that they were first sold for domestic premises. The Electrical Development Association first advertised Unit Plan heaters in 1962, primarily to meet the demand for a low cost, high-amenity, heating system for existing houses, although Unit Plan heaters are also installed frequently in new houses. But the demand exceeded all expectations; manufacturing and installation facilities were insufficient and had to be increased materially before the following heating season.

Electricity Boards recommend a minimum installation per house of two Unit Plan heaters at about £30 each including wiring and installation, with additional heaters as and when required. Installation work is simple and speedy, all that is required being an off-peak circuit to the desired position of the Unit Plan heaters, a time switch and a meter, There is no builders' work and no pipes to be installed, with consequent saving of time and inconvenience and the preservation of decorations. Although in operation Unit Plan heaters are automatic, they may be controlled as to input and temperature requirements by hand, but no other attention is required—no stoking or fuel store, no ash disposal, dust or smell.

There are now, in total, about 900,000 Unit Plan heaters in use in Great Britain, and last year about 320,000 were installed. Market research has shown that 95 per cent of domestic users are satisfied with them and 75 per cent said they were recommending Unit Plan heaters to their friends.

Unit Plan heaters are also available with damper control output and are particularly suitable for rooms used intermittently such as dining rooms. The chill is kept off the room with the damper in the closed position, and the damper is opened by hand when a higher room temperature is required.

Since their introduction for domestic use in 1961, there have been developments and improvements in Unit Plan heaters, not only through the work of industrial designers in producing heaters of more pleasing appearance than the earlier commercial models, but also in their electrical and thermal characteristics. Research has been performed on the composition of a variety of refractory materials—concrete blocks of various forms, fire clay and other ceramics, and on the construction of the heat-storing material as a means of improving the heat flow. Control methods have been improved and quiet fans have been incorporated in the forced convection heaters.

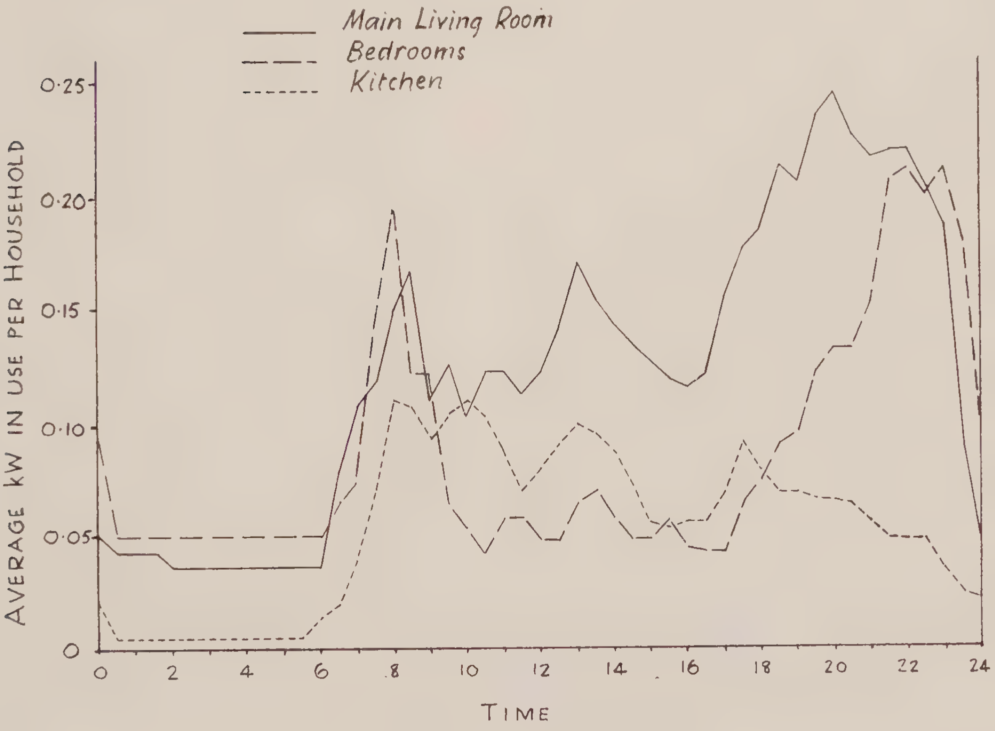
Warm air heating is the third form of electric off-peak heating. The simplest form of this is, in fact, the forced convection Unit Plan heater which provides warm air into the room, blown through passages in the heated refractory material by an electric fan. This may be controlled by room thermostat or by hand at the desire of the occupants and, as with the damper controlled Unit Plan heater, a reasonable background temperature is maintained when the room is not occupied, heat-comfort conditions being quickly attained by the operation of the fan. A centrally sited warm air heater may be fixed in a cupboard, say in the kitchen or under the stairs, and ducts provided to bring the warm air to the individual rooms. This form of electric heating has been developed over several years and large-scale tests carried out on housing estates in various parts of the country, with very satisfactory results. Warm air heating has been used for many years in the U.S.A., Canada, and elsewhere and there has been a growing demand for this form of heating. Of course, the winter climate in Canada and parts of the U.S.A. is much more severe than that experienced in Great Britain, but the popularity of warm air heating in this country has been demonstrated by the sale of about 240,000 electric convectors and an increasing number of gas warm-air installations in 1964. Now that electric warm air central heating has become established at a competitive cost, under the new title "Electricaire", a rapid increase is anticipated for this form of off-peak heating.

In referring to "heat-comfort", the phrase has been used "the occupants of a room". But which room? Heating requirements vary from room to room and in each room, from one time of day to another. The figure below shows the average electric space-heating load in use in main living rooms, bedrooms, and kitchens (28th January, 1965) in households having electric heating.

In considering the differences in electric heating shown in the curves, it should be recalled that the majority of living rooms and many kitchens have solid fuel fires and that kitchen heating is augmented by the use of electric and gas cookers. (A large-scale sample survey carried out in 1963 showed that, in normal winter weather, 75 per cent of households use solid

AVERAGE SPACE-HEATING LOAD IN USE IN VARIOUS ROOMS – 28TH JAN 1965

(PER HOUSEHOLD HAVING ELECTRIC HEATING)



fuel fires at some time during the day, 25 per cent use electricity, 6½ per cent use gas, 4 per cent paraffin, and 1 per cent fuel oil. These figures indicate that many households use more than one fuel).

Relatively few bedrooms use solid fuel fires and the curve is probably a close indication of bedroom heating, showing a pronounced peak in the late evening. (In the investigation referred to above, it was found that 11 per cent of households used electric heating in bedrooms, 4 per cent solid fuel, 2 per cent gas, and 1½ per cent paraffin. Bedroom heating is still regarded as something of a luxury in normal winter weather when it is used by only a quarter of households with electric heating available in their bedrooms, but this proportion rises to three-quarters in very cold weather).

The three curves refer only to main living rooms, bedrooms, and kitchens. Data are not available for bathrooms, where heating would probably be similar to bedroom heating, or for subsidiary living rooms, where, on average, the electric heating load is materially less than in main living rooms, as in very cold weather households will tend to use only their main living room.

Research into present heating practice must not overlook the fact that in many households heating is still inadequate. Information must be sought on the heating which householders would like to have, particularly in Smoke Control Areas. With this in mind, a sample survey was made in 1963 of approximately 1,200 households, and housewives, having an open fire in their main living room, were asked what heating arrangements they would choose if where they lived became a Smoke Control Area. It was interesting to find that, under these circumstances, 31 per cent said they would wish to have an open fire with smokeless fuel, 9 per cent a solid fuel closed stove, 13 per cent gas, 26 per cent electricity, while 21 per cent would wish to have some form of central heating by various fuels. However, other surveys have shown a greater preference for central heating as a long-term aim.

The future of domestic heating depends on a number of factors, the principal one being the public demand for better standards of heating. There is, too, the official recognition for improved heating in houses. The Parker Morris Report indicated this by the words—"it is time to recognize that a home without good heating is a home built to the standards of a bygone age . . ." The building programme of 400,000 houses or so each year, the schemes for improvement of existing houses, and the gradual increase in the extent of Smoke Control Areas are all factors offering great opportunities for achieving better heating. This is not merely the opportunity for more heating—indeed, with higher standards of thermal insulation of houses, there is the opportunity of using heat to better advantage and, in doing this, the public desire for central heating indicates the need for a more rational approach to domestic heating, regarding the heating system, together with the thermal insulation, as a fundamental engineering service of the building. This implies calculation and design, in order to satisfy the basic needs of occupants and allow for their having such additional heating as they may choose. And, moreover, to ensure that the heating will be economical in construction, operation, and maintenance.

No doubt a variety of views will continue on the merits of full and partial central heating but, having regard to economy, there is little doubt that partial central heating schemes will continue to predominate. It is desirable that this should be so, as partial central heating allows a reasonable element of consumer-choice on the heating of each room.

With these points in mind, the building of new houses, where electricity is to be used for central heating, has a number of possible solutions—full or partial central heating; floor warming, Unit Plan heaters, or Electricaire heating, and the auxiliary use of electric fires, convectors and other forms of electric heating such as the newer developments in electrically heated wall panels and ceiling panels.

The first problem, however, is the thermal insulation of the house. The extra cost of thermal insulation, and, in many cases, of double-glazing, is justified by the saving in fuel bills. Present standards are still not adequate for future needs and urgent action is needed in the agreement and operation of new, improved insulation standards.

The second problem is the heating service to be given by the electric central heating installation. The most suitable, being economical in cost and in operation, is one providing full heat-comfort in the main living room, with reasonable background temperatures in other rooms. In these other rooms, there are fixed electric fires—an arrangement already adopted in many houses for dining rooms, kitchens, bedrooms, and bathrooms—in order to ensure that, at short notice, the average temperature may be increased as and when required. Householders may, if they wish, purchase small portable appliances, including those with lighting effects such as glowing log fires, to meet their personal wishes for heat-comfort.

If floor warming is installed, it must obviously be installed during the construction of the house. Where Unit Plan heaters are installed, however, additions may be made from time to time, and Unit Plan heaters may also be installed in any part of the house, if it should be so desired at some future time, as an addition to partial central heating installations by floor warming or warm air. In all cases, the heat input to the different rooms would be under hand control as well as time switch and, where desired, thermostatic control. Of course, during the building of a house, proper arrangements are necessary for the correct amount of ventilation, either by flues, where these are provided, although there is much to be said for avoiding the extra expense of flues as well as fuel stores and providing adequate alternative means of ventilation.

Assuming then a two floor house of 900—1,000 sq. ft.—the size of the majority of houses being built today—and having reasonable heat insulation, a satisfactory central heating installation is a 6 to 8 kW Electricaire system, having the unit sited under the stairs or in a suitable cupboard, with ducts serving the ground floor rooms and possibly a bedroom or two. Fixed electric fires would also be provided in the bedrooms and bathroom. In this way, the higher standard of heating advocated in the Parker Morris Report may be provided, together with those other desirable features—convenience in use, flexibility, and control over expenditure.

The main fan for the Electricaire unit is controlled by a thermostat with an overriding switch giving a boost speed for quick heating up, and the heat flow into each individual room may be reduced or cut off completely by a hand damper. The fixed electric fires are also, of course, controlled by hand.

Electricaire installations may also be used to provide central heating in existing houses, although constructional alterations are required to install the heater and the necessary air ducts. The simpler method—used in most cases—is to install Unit Plan heaters but, as the heat insulation of most existing houses is generally not good, a larger central heating installation would be necessary than for a well-insulated new house.

With heating arrangements of the nature described above, there is both economy and adaptability to meet the householders' needs. Electricity supply is on an off-peak tariff for floor warming, Unit Plan heaters, or Electricaire heaters, and on the normal domestic tariff for the auxiliary heating by electric fires.

Much has been said in criticism of the effect of the electric fire load on the Electricity Boards' available capacity and the serious additions which electric fires make to "peak" demands, i.e. 5.30—6.00 p.m. on week-days in cold winters. Such criticism is perhaps justly applied to heating of main living rooms by electric fires, but the use of electric fires in other rooms is not a load which adds materially to "peak" demands. Indeed, there is a large use of such electric fires when the normal demand on the system is low and, far from being embarrassed by the use of electric fires in subsidiary rooms, Electricity Boards can welcome it as a good load.

There has been concern among consumers and local authorities about the increase of electricity tariffs during the last two years, and assurances are naturally sought about the future. The increases which have occurred recently have been due largely to the need for a greater capacity to meet the increasing demand for electricity, coupled with the need to achieve a higher rate of return on capital employed to meet Government policy. At the 1964 Clean Air Conference, I referred to electricity tariffs as follows:

> "The principal anomalies in domestic tariffs have now been corrected, or are in the process of being corrected, and I think that over the years ahead the ratio of average domestic price for electricity to the retail price index should be relatively stable."

The round of Area Board tariff increases, to which I referred, has now been completed.

The increases which have been made in recent years in domestic tariffs have not applied to off-peak tariffs. Some, in fact, have remained unchanged for many years, although others have had changes either by way of price increase of a smaller amount than in the corresponding domestic tariff, or adjustments of the restricted hours. The general position in most Area Boards is now that for off-peak supplies of 11 hours, i.e. night supply plus afternoon boost, the price is about one-half the normal domestic unit charge.

The majority of electric central heating installations use an afternoon boost, but some time ago a rumour became current that Area Boards may withdraw this facility on the grounds that the afternoon "valley" of the load curve had been filled and hat, in consequence, it was not longer available for off-peak supplies. This suggestion is quite incorrect. There is still an afternoon "valley" in the load curve and this shows no signs of being filled! To dispel any apprehension caused by this rumour to those who had installed, or were thinking of installing, off-peak central heating systems, the Electricity Council issued a statement in 1964 and I repeat it now with full emphasis:—

> "Storage heating installations use electricity supplied outside hours of peak demand and many of them receive a boost during the afternoon. I can give you an assurance that the Boards will be able to provide a day-time boost for all present thermal storage heating installations and those purchased in the foreseeable future and that, compared with normal domestic tariffs, the off-peak tariffs available will continue to be advantageous."

As for the future, there will be an increasing use of electric central heating installations in new and existing houses, whether of traditional or industrialized construction. The various types of electric central heating are appropriate; they have been proved by the practical experience of householders; they are not only acceptable but popular; and they are economical in cost.

Discussion

P. Draper (Individual Member) suggested that delegates might not appreciate the significance or scale of the sulphur in oil figures quoted by Mr. Brewster in his Table A. He thought the perspective was best obtained by comparing them with those from other domestic fuels as shown in the following table.

Fuel	*Average Sulphur per therm (lb.)*
Solid	
Coal	0.128
Coke	0.133
Liquid	
Domestic Fuel Oil	0.041
Light Domestic Fuel Oil	0.004
Paraffin Oil	0.002
Gas	
Town Gas (coal)	0.006
Town Gas (oil)	0.001
Petroleum (Bottled) Gas	0.0002

The figures did not take into account the heating efficiency of the domestic heaters concerned which tended to amplify the differences tabulated.

With reference to Mr. Bruce's paper, Mr. Draper considered the Conference platform not the place to discuss prices and made a strong plea that delegates and the press would not take Table I of Mr. Bruce's paper out of context.

The Table based on American data had no bearing whatever on U.K. prices and in his opinion was unlikely to do so in the future.

Dr. D. Davies (Individual Member) said that the cost of smokeless fuel naturally gave rise to discussion but it was important that we should not be haunted by the picture drawn by the eloquent lady from Salford who on Tuesday had described the old-age pensioners without fires. Her heart was obviously in the right place but she did not put forward the correct remedy.

She was dealing with the very poorest section of the community and it was worth considering why some of those were so poor. Many of them would have been widows for years and chronic bronchitis created about 20,000 new widows a year and cancer of the lung another 20,000 or so. In other cases the husband would have been a chronic invalid for years with greatly reduced earnings before his retirement—and chronic bronchitis was one of the most important factors in that problem.

The sensible solution was for such people to get help from the National Assistance Board—that, after all, was the statutory duty of the Board. If they were already on National Assistance and that seemed insufficient to buy fuel, then the Welfare Department should investigate the reason for that. It would be a grave mistake to delay the introduction of Clean Air for reasons of that sort. Our pensioners needed and deserved clean air as much as anyone else.

G. W. Dhenin (Bath) remarked that all four of the admirable papers presented were full of interesting facts, figures and crystal gazing and provided an Utopian outlook on the future of house warming—greater comfort, lower costs and, most important, cleaner air.

He considered this state would come all the quicker if the Minister of Power implemented his Fuel Policy Report in which each type of fuel, whether solid or piped, could be slotted into its appropriate place in the scheme of providing heat in the home.

He believed in competition as a spur to development but felt that the present-day cut-throat competition and rivalry between the sales forces on the National Boards were neither necessary nor reasonable. Mr. Dhenin said it took over £6 million a year out of the national kitty to put on this super salesmanship. He went on to accept that the housewife must have freedom of choice as to the fuels and appliances she used and made a plea for Advice Centres instead of the typical and elaborate Board showrooms and at those Advice Centres all forms of heating, even by oil, could be discussed and advice given as to the merits of one fuel or appliance against another in a given situation.

He believed that if the National Boards wanted to increase sales whether of solid smokeless fuels, gas, electricity or oil (B.P. was a semi-nationalized industry) there were two simple things needed—

1. Bring down the cost of the appliance to an economic level, and
2. Reduce tariffs, even fractionally.

Mr. Dhenin was extremely interested to note the present upsurge in district heating. Some fifteen years ago enthusiasts like Hazel, Duguid and Donald Smith, all sponsored district heating but for one reason or another it never developed. He saw a big future for it, particularly in the solid fuel field in new town development. Of course we had to admit that the electricity grid and super grid and the elaborate gas grid were in essence district heating.

Mr. Dhenin pleaded again for a practical National Fuel Policy where each fuel, whether solid or piped, or nuclear in origin, from Pontardawe or Pensett, from Seabank or Holland, from Bradwell or Battersea, should be given a place in the national plan.

Finally he stated he believed strenuously in Clean Air and emphasized that bituminous coal was not acceptable as a fuel but was one of the most valuable raw chemicals indigenous in this country.

F. F. Ross (Central Electricity Generating Board) said that, speaking as a consumer, it seemed that the solid fuel interests were honestly fighting a losing battle; that the case for oil (and for gas made from untaxed oil) was misleading; and that electricity was failing to make the most of its opportunities. The losing battle lay in the inability to deliver an ashy fuel at less than a shilling a therm. As for oil, crude oil came into this country with about 2 per cent sulphur content; this meant that for every ton of distillate with very low sulphur there was in effect a ton of fuel oil with 3–4 per cent sulphur. The old scheme was to send this to power stations so that the sulphur oxides came down in the North Sea, but the advent of economic nuclear power would reduce the scope for this. On the other hand the true marginal cost of "coal-by-wire" during the night, using equipment that would otherwise be idle, was a good deal less than 0.9d. per unit or 2/1 a therm, and unless all possible steps were taken to make its use attractive, electricity might lose much needed load to imported methane.

T. Henry Turner (Individual Member) said that the future use of storable solid fuels, in domestic heating, might now depend on the development of the principle of under-fire fuel supply.

The competitors of solid fuels were gas and oil both of which were efficient and smokeless only when they were delivered under the fire, at a steady rate. Much experience with screw feeds for solid fuels, in tens of thousands of industrial furnaces, had proved the under-fire feed to be smokeless, most efficient, and clean. The time had come to apply under fire solid fuel feeding to the smaller domestic fires.

Miniaturization had advanced in many branches of industry. The Baxi domestic fire makers now offered fan driven air control. There was no reason why electrically operated or foot pedal operated screw feed for solid fuel and electric fan variable pressure air supply should not now be made available for domestic use.

An "open fire" with under-fire fuel feed would be smokeless and efficient. An "open fire" with fuel put on the top of the fire would always be less efficient than one with the fuel added below the fire.

Mr. Turner wished to know how much money had been allocated to research and development of under-fire fuel domestic fires by the following:—

Ministry of Technology
National Coal Board
Coal Utilization Council
B.C.U.R.A.

He recommended that these bodies minute this recommendation as important for the sales of any solid fuels in twenty years' time. That was the sort of time ahead for which their present planning was needed. By then they would have lost the domestic solid fuel market entirely; unless some such devices as miniaturized screw feed for under-fire fuelling was developed.

Councillor A. A. Loughton (London Borough of Wandsworth) said that the London Borough of Wandsworth were at present considering alternative heating methods for a number of large housing schemes, some running to an overall cost of several million pounds.

They were advised that one of the disadvantages of using gas for central heating was that gas pressures were liable to vary and the efficiency of the installation could thereby be affected. This was most certainly a possibility and it had influenced their choice. Councillor Loughton mentioned that tenants on some of their housing estates with electric background heating had found that in cold spells when they used their own apparatus to top up the heat, the thermostatic control of the background heating switched off. His Council had the experience of tenants breaking the seal of the thermostatic control and altering the clock.

K. T. Diamond (Coal Merchants' Federation of Wales) addressing his question to Mr. R. N. Bruce and Mr. C. T. Melling, asked if when gas and electricity undertakings were disseminating information regarding space heaters and their costs, they could not make it quite clear to householders that when replacing a solid fuel fire with back boiler, separate and additional arrangements often had to be made for hot water.

He added that with a modern solid fuel appliance sustained warmth and hot water could be obtained from one unit at very low cost and recommended that delegates who had not already done so, should visit the excellent Exhibition in the adjoining building, where many attractive solid fuel appliances could be seen under fire burning solid smokeless fuel.

Councillor Mrs. I. Jones (Hyde) asked whether the electricity authority was now prepared for all demands for "off-peak" and other electricity in view of the increasing number of smoke control areas and could any guarantee about price be given. Was it possible to standardize the charges throughout the country since some area Boards charged more than others?

E. W. Ward (Warrington) said that freedom of choice of appliances in smoke control areas had been a fallacy. For almost nine years, by Ministry direction, grant aid had been restricted to the cost of installing open fires. Hundreds of thousands of these miserably inefficient appliances had been installed. Now local authorities had the opportunity to pay grant on efficient appliances he hoped that the increased production of premium fuels would not bring local authorities back full circle to the previous unsatisfactory situation.

He referred to a request from the platform for the establishment of "Heating Advice Centres" and suggested that any local authority who purchased a house or business premises for the purpose would find the principal suppliers of fuels and appliances only too willing to co-operate in equipping the centre.

Councillor J. Sanders (Warwickshire Clean Air Council) said that on three occasions in the past, when similar papers to those given that morning had been presented, he had accused the platform of portraying an exhibition of high pressure salesmanship. On this occasion, however, there appeared to be a softening up of such a policy, and each speaker had given a genuine contribution which could help in the formulating of a National Fuel Policy.

The Clean Air Act came into being in 1956 and in his opinion, the Government as yet had only paid lip service to it, and the local authorities had tried to move too fast. Indeed, they had had to slow down and even suspend the making of further smokeless orders due to shortages of suitable solid smokeless fuels and various other reasons. But, at long last, they were moving on the right lines and it would appear that the appeals made at previous conferences had been heard and a White Paper on a National Fuel Policy had now been published.

For the information of delegates a resolution would be put the next day (Friday) for an improved Fuel Policy and he trusted it would be unanimously supported.

Mr. Brewster had made his case out for domestic heating by oil, which should be noted and Councillor Sanders had no further comment to make.

Mr. Bruce's contribution was amazingly revealing and if his crystal reading proved true in relation to the gas findings in the North Sea then it would be of great benefit to the Nation.

Dr. Reid, a colleague from the National Coal Board, Councillor Sanders wished to compliment on his presentation and to suggest that his was a magnificent example of the force and drive which should be used by the Board's Marketing Department.

With Mr. Melling from the Electricity Board, he had no quarrel. His undertaking was the miners' best customer.

All four speakers had indicated and made it abundantly clear that a National Fuel Policy was necessary. A healthy competition, using all those forms of heating should be continued, said Councillor Sanders, but our aims should be those of this Society to make a better and healthier land to live in.

Finally, he commended to conference the Old Warwickshire Miners' Motto:—

Let us onward for the right nothing more,
And let justice be the might we adore,
Build no hope upon the sand
For a people (*Society*) *hand in hand*
Can make this a better (*healthier*)
Land than before.

F. F. Robb (The Gas Council) pointed out that the competitive situation which obtained in the fuel market necessitated the use of modern marketing methods. Salesmanship and advertising by each of the fuel producers contributed to increasing output and lowering costs both of the fuels and of the appliances. These could also assist in the promotion of an increased awareness of the objectives of the Society itself.

Authors' Replies

Mr. Melling in reply to Councillor Mrs. Jones said that he could give the undertaking for which she asked in the terms of the penultimate paragraph of his paper. It was unfortunately not possible to standardize the charges for off-peak supplies throughout the country owing to the difference in the costs which the Boards had to meet, but, in all cases, the off-peak tariffs now offered by the Boards were very favourable for domestic heating.

Mr. Bruce, replying to Mr. Ross's remarks, said that the natural gas was being brought in by the gas industry as a separate feedstock and not in association with crude oil. As a result no fuel oil came with it, and therefore there was no import of additional sulphur as had been suggested by Mr. Ross.

In reply to Mr. Draper, Mr. Bruce said he had not got his point home. What he was saying about the U.S.A. figures was not to compare them with this country at this time, but that over the period 1950–1962 because of the enormous amount of natural gas that came into the U.S.A., the relative price there of natural gas to other fuels, went down. The same thing, to his mind, would happen in this country if and when, say in ten years' time, similar quantities of natural gas were available in this country.

Mr. Bruce said he was sorry about the remarks by Councillor Loughton about gas pressures, because this was in his own area and he was sensitive about it. They were spending large sums of money in improving pressures, and they had a philosophy in the Board that every member, and every employee of the Board, should report wherever there was inconvenience of this kind. He would look into the matter and see if supplies could be improved. (Correspondence with Councillor Loughton has taken place since that date).

THE SELECTION OF INDUSTRIAL DUST COLLECTION PLANT

by

John Hodgson

ABSTRACT

The nature of grit, dust, and fumes are discussed, and the types and systems available for their removal are described, and advantages and disadvantages of different methods noted. The methods are reviewed under the main headings of settling chambers, inertial collectors (cyclones), fabric collectors, wet collectors, and electrostatic precipitators. The paper concludes with information and observations relating to the selection of equipment for different requirements, and it is emphasized that the problems of industrial dust collection are complex and that selection is best left to the specialist.

1. Introduction

WITHIN the past few years the subject of dust collection has been brought into prominence by industry in general. The reasons for this awakening of interest are to be found in the much-improved working conditions of today. In parallel with this there is full employment in most areas with the result that employers must offer healthy, clean factories to which people will be attracted. It would be foolish indeed to pretend that all managements and boards of directors willingly install plants which in the majority of cases do not assist production nor make any contribution to the efficiency of the product. The equipment must, of necessity, be regarded as part of the unproductive costs and therefore as a necessary evil. Nevertheless, more and more dust collection plant is being installed, due in part to the implementation of the Clean Air Act, 1956, which states specifically that all reasonable measures must be taken to prevent emission of dust and grit from workplaces.

The prevention of lung disease due to inhalation of fine dusts is also concerning the factory inspectorate which is now insisting on preventive measures being taken. The result has been that some industrial managements have tried to overcome the various problems by selecting the cheapest equipment available, irrespective of its suitability for the job in hand. In the elimination of one nuisance another is created with the result that further expenditure becomes necessary and the overall cost of the final installation is higher than if the matter had been tackled correctly in the first place.

It cannot be emphasized too strongly that industrial dust collection is a highly specialized field and selection of the correct equipment is best left to the expert. Specialist companies have facilities for the analysis of dust and also design staff who can interpret such results.

2. The Nature of Grit, Dust and Fume

The terms " grit, dust and fume " are usually loosely used but it is essential for an understanding of what the various terms imply. In each case the difference is that of particle size. For the purpose of this paper the size range will be as follows:—

Grit ..	Over 76 microns (200 mesh)
Dust ..	Over 10 microns, less than 76 microns
Fume	Less than 10 microns

The unit used for the measurement of dust is the micron which is $\frac{1}{1000}$ m.m. (0·00004″). The particle size of a dust is determined in the laboratory by means of certain standardized tests including sedimentation, elutriation, microscopic analysis and so on. It is not intended to discuss this subject since it is much too complex for inclusion within the scope of this paper but there is, however, one point of some importance which must be mentioned. The standard test methods are perfectly satisfactory down to the five-micron range, but below this size an accurate dust sizing is difficult to obtain except with the use of such specialized equipment as the electron microscope.

When the selection of a dust collection plant is to be made, it is most important to have as much information about the dust to be handled as is possible to obtain, including:—

(*a*) Particle size distribution range. (This is normally stated as a sieve test down to 200 B.S.S. mesh. Below this range the size is stated in microns).

(*b*) The bulk density of the dust. (This enables the design of suitably sized hoppers to be made).

(*c*) The specific gravity of the dust. (This is particularly important when the design of inertial collectors is involved).

(*d*) The shape of the dust particles, whether irregular, crystaline, spherical, etc. (This has an effect on the packing of the dust in hoppers and is also useful if it is to be passed through small apertures).

(*e*) The temperature of the air stream. (This factor is very important indeed. Certain types of dust collector have limitations as to temperature due to deterioration of fabric, water evaporation, etc., and care must be taken in considering this aspect. In this case of inertial collectors such as cyclones, the pressure drop is altered by temperature rise).

(*f*) Humidity of the air stream. (Some collectors are affected by humidity, particularly if the temperature of the air stream is permitted to drop below its dew point. This will be enlarged upon later).

3. Types of Equipment Generally Available

It is now proposed to give a brief outline of the various types of equipment available for industrial use in this country. To describe each type of plant in detail is of course quite impossible in the space of a paper such as this and in addition, there are so many variations of any particular type that the job of describing each is quite impossible. The comments made are therefore confined to the broadest outlines.

Generally speaking, gas cleaning plant can be divided roughly into five classes. Some collectors combine features of two or more of these classes of collector. A necessarily brief description of the main types of collector will be given but it will be understood that it is quite impossible to go into design details. Each type could in fact be the subject of a paper in itself.

(A) Settling Chambers

This is the simplest kind of dust collector, in which the dust-laden air stream is passed into a large building or box and as a result its velocity drops. Particles of dust which have been carried in suspension in the air stream tend to settle out as the velocity drops and fall to the floor from which they are removed periodically. The efficiency of such collectors depends upon the settling rate of the dust particles and the lowest air velocity in the settling chamber. This is largely dependent on the particle size of the dust concerned. It is of course possible by using Stoke's Law to determine the rate of settlement in still air of dust of known specific gravity and of varying sizes.

It will be seen that the rate of fall of the smaller particles is very slow indeed and under such circumstances unless the velocity of the air stream passing through the settling chamber is very low and therefore the chamber very large indeed, it is quite impossible to settle out such particle sizes. Obviously the conditions imposed are often impossible to achieve and therefore settling chambers are rarely successful.

Variations in design are often incorporated, such as introducing labyrinth passages with frequent directional changes. This has the effect of increasing the pressure loss across the collector without materially increasing the efficiency. The introduction of water sprays is also a frequent variant but these are of little use either. Further reference will be made on the use of water sprays later in this paper. Settling chambers are suitable only for dusts or grits of large particle size. (See Fig. 1).

(B) Inertial Collectors

We now come to the class of plant known as inertial collectors. The best known of this type of plant is of course the cyclone.

(*i*) *Cyclones*

Cyclones are made in various forms varying from the relatively large diameter unit of moderate height to the long, slim, high efficiency unit. Between these two extremes are a large number of designs including cyclones with a curved axis, with internal vanes, with guide vanes on their inner walls, etc., but it is proposed to deal only with the main types here. Before doing so, a brief comment on the working of a cyclone is necessary.

When dust-laden air is introduced into a cyclone it is immediately given a rotary motion which causes centrifugal force to act upon the particle and throw it outwards to the cyclone wall, at the same time being carried downwards to the bottom of the cone when it is discharged into a dust container. The air then forms an upward moving vortex which passes out through the discharge outlet. Any particle upon which this centrifugal force is applied is also subject to the viscous drag of the air

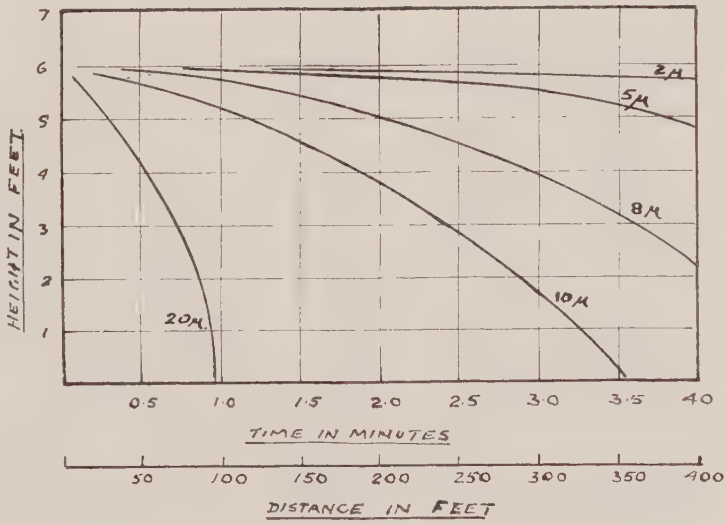


FIG. 1 DIAGRAM SHEWING THEORETICAL FALL OUT OF DUST (S.G 2.7) IN AIR STREAM AT 100 F.P.M.

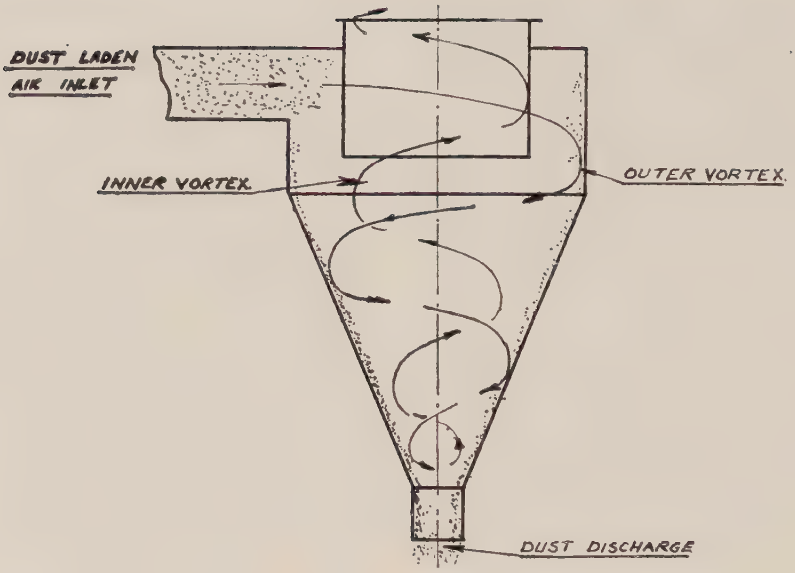


FIG 2 DIAGRAM OF OPERATION OF CYCLONES.

so that the speed of movement outwards to the cyclone wall is the result of the difference in the applied forces. (Fig. 2).

It will be clear that an extremely small particle will only pass outwards very slowly and therefore it is unlikely to reach the cyclone wall before it is carried upwards by the inner vortex and discharged through the outlet. The performance of cyclones can be improved by:—

(*a*) Increasing the angular velocity, thus increasing in turn the centrifugal force on the particle. Increasing the angular velocity can be achieved by increasing the throughput or by reducing the diameter, but it also increases the likelihood of formation of eddies in the air stream which cause re-entrainment of particles in the air stream.

(*b*) Increasing the length of the cone so that the length of time the particle is under centrifugal action is increased. However, there is a practical limit to the length both by reason of manufacturing and installation. It has been found experimentally that there is an optimum length of cone related to diameter over which the increase in efficiency is so small as to be insignificant.

(*ii*) *Medium Efficiency Cyclones*

The most common cyclone used in industry is the rather large squat type which is seen principally in saw-mills and the like where the dust is fairly large in size. The conical section is approximately equal in length to the diameter. The performance of such units is only good down to about 60 microns and below this size drops away gradually until at 10 microns the dust collection efficiency is only about 20 per cent. All figures quoted in this paper are based on dust with a specific gravity of 2·7 grains per cubic foot. The pressure drop across such cyclones rarely exceeds 2″. (Fig. 3).

(*iii*) *The Long Cone High Efficiency Cyclone*

The reduction in diameter, coupled with an increase in cone length of these cyclones, has the effect of increasing the efficiency for the reasons stated earlier and is undoubtedly a much better and sounder proposition. Such cyclones, however, have a smaller throughput and, therefore, a greater number must be used to deal with the same volumes. A typical grade-efficiency curve is shown herewith. (Fig. 4). If this is compared with the curve for the medium

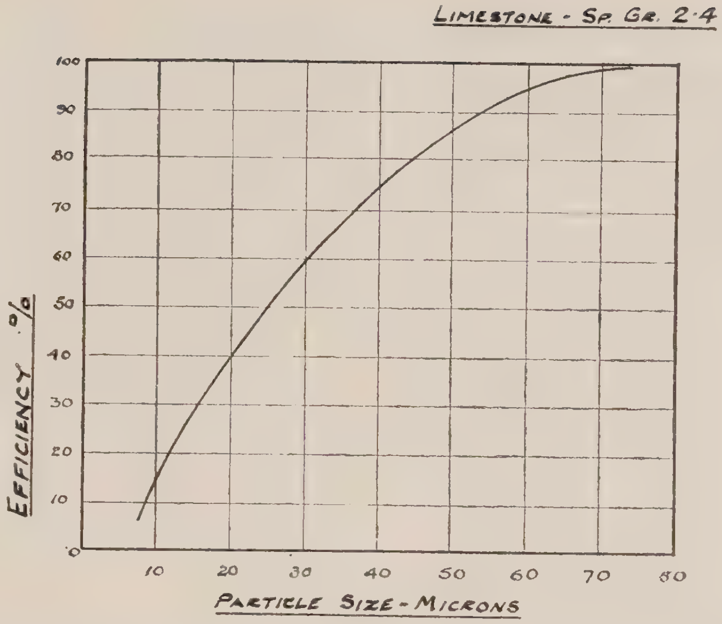


Fig. 3 - Grade/Efficiency Curve - Medium Effy. Cyclone

efficiency unit it will be seen that there is a very marked increase in performance. The pressure drop across such units is of course higher and is usually of the order of 3″ to 4″ water gauge.

Theoretically, the smaller the diameter of cyclone, the higher is the collection efficiency and hence it is usual to nest high efficiency cyclones in units of two, four or six. It is not usual to nest greater numbers owing to air distribution troubles.

(*iv*) *Cellular Cyclones* (*Fig. 5*)

These are an attempt to fulfil the conditions of small diameter cyclones with high angular velocities, thus giving high efficiency figures. Provided that sufficient attention is paid to design, these units are very successful. Once again, however, there are a number of points which must be considered.

When the size of the cyclones, or cyclone cells, is reduced, obviously all the passages become rather small and if not carefully designed can plug up. The effect of this plugging in a few cells is that the overall efficiency of the collector drops rapidly. In cases where the air stream is humid a fall in temperature to the dew point causes plugging very rapidly

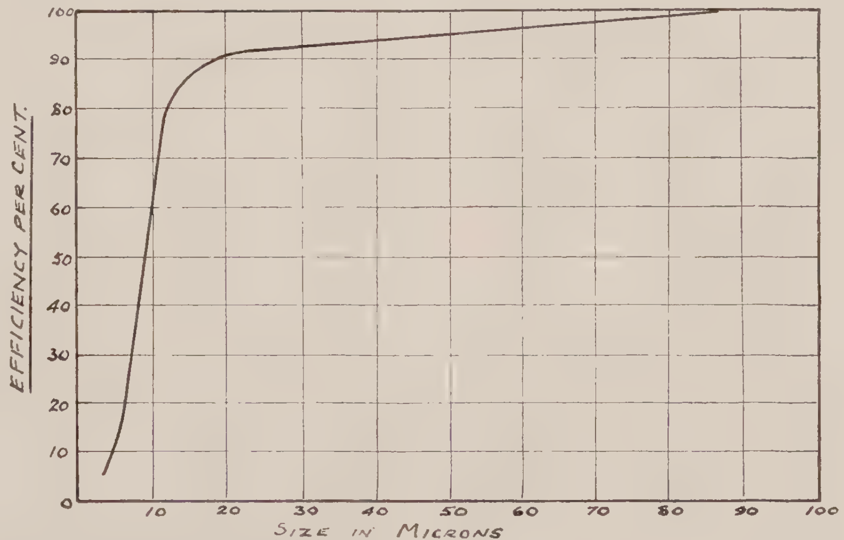


Fig 4 Grade/Efficiency Graph for H. E Cyclone

indeed with resultant failure of the collector.

Where heavily loaded air streams are to be dealt with it is often advisable to remove most of the dust by passing it through a pre-cleaning plant such as an ordinary cyclone.

The point of most difficulty in the use of cellular cyclone plants is undoubtedly the achievement of equal air distribution over all the individual cyclones. Uneven loading brings on plugging and once again with consequent loss of efficiency (Fig. 6).

(*v*) *Irrigated Cyclones*

One method of increasing the efficiency of cyclones is by means of irrigation of their walls or by thoroughly mixing water in the form of droplets with the entrained dust. Both methods have been satisfactorily employed.

In the first instance, water is introduced tangentially at four points on the parallel portion of the cyclone and thoroughly wets the surfaces. Any dust impinging thereon is carried with the water and danger of re-entrainment in the air stream is eliminated. This system is used extensively when materials are in suspension such that they would adhere to the cyclone walls.

The second system introduces water into the air stream where it is thoroughly mixed with the dust thus increasing its mass and thus imparting to it a higher centrifugal force.

Both systems require alterations to the cyclone itself, a circulating pump, and a reservoir tank. The amount of water added to the system must be carefully calculated, otherwise carry-over through the cyclone discharge will almost certainly result.

(C) Fabric Collectors

Apart from the cyclone, the bag filter is probably the most common type of collector used. In fabric collectors dust is removed from the air stream by passing it through a fabric in the form of sleeves, stockings or panels, the dust remaining on the fabric. The manner in which the collection takes place on fabrics is not generally appreciated. (See Fig. 7). The fabric itself does not, as a rule, act as a filter but as a matrix on which a filter bed is built up. What happens is that the fibres in the material entrap dust which builds itself into a filter bed which then effectively filters dust from the air stream. When it is cleaned by shaking or vibration, or by other methods, most of the dust is removed but

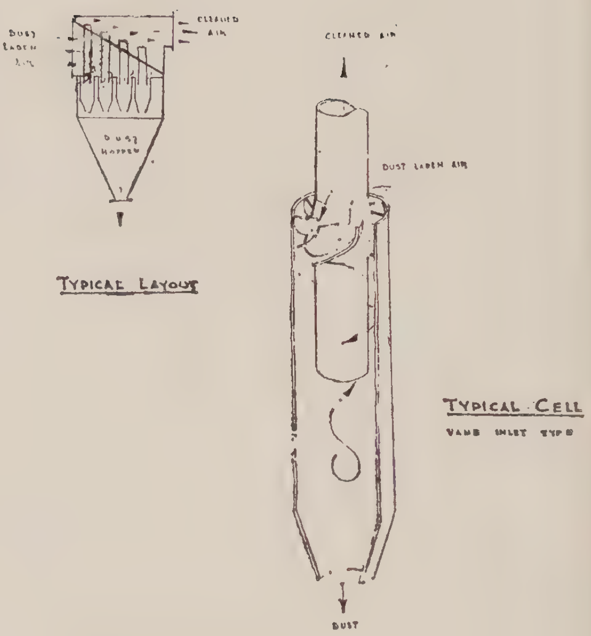
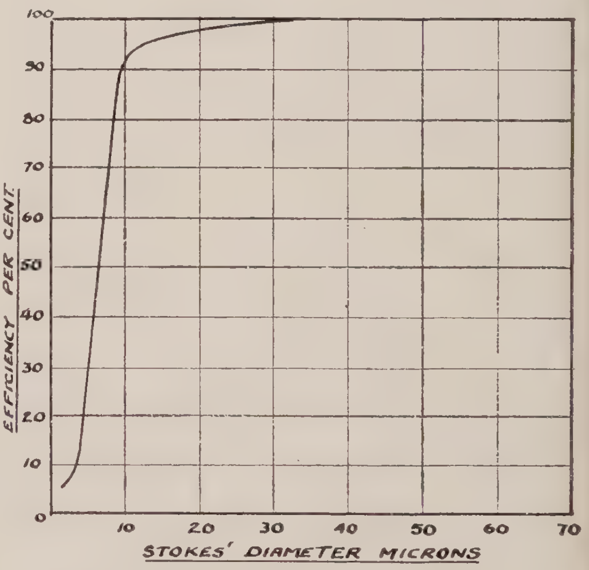


FIG. 5 – DIAGRAM OF TYPICAL MULTICYCLONE NEST



MATERIAL – LIMESTONE

FIG. 6 GRADE-EFFICIENCY GRAPH FOR CELLULAR CYCLONE UNIT

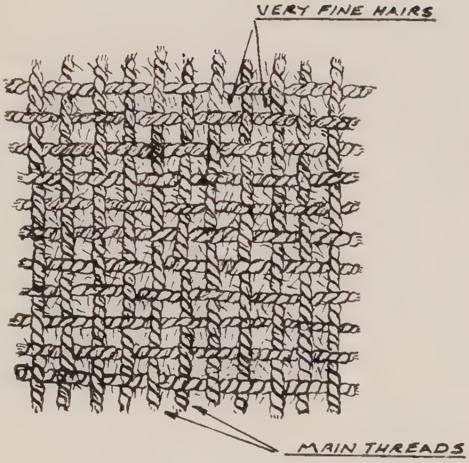


FIG 7 DIAGRAM OF FILTER FABRIC

sufficient is retained in the interstices to form the filter bed.

The choice of fabric filter type depends almost entirely on the kind of process, the dust loading of the air stream, and the general conditions applicable. (Fig. 8). The simplest is the pressure type collector which is manually cleaned during shutdown periods. In this instance the dust-laden air is passed into the collector through the fan and the cleaned air out to atmosphere through the fabric sleeves or stockings. Dust removal from the material is carried out by shaking the bags which are usually secured to a frame which can be moved upwards and downwards thus agitating the bags or sleeves.

A similar type of plant can of course be constructed to operate under suction, that is with the cleaned air passing through the fan. There are, however, one or two features which have to be taken into account in such a design. Firstly, the collection plant itself must be air-tight, otherwise atmospheric air can enter thus destroying the efficiency of extraction and, secondly, when the sleeves exceed 8 ft. in length some method of ensuring that the bag does not collapse under suction must be incorporated. This is done by sewing a rustless steel ring, or rings, into the cloth according to the length.

When a bag filter is required for dust from some continuously operating process, special designs of collector are available. In almost every case these plants operate under suction. The principle involved is that the plant is constructed in sections, each of which is a unit in itself. Each section is shut down in turn by the automatic closing of a damper or valve and is cleaned by shaking before being put back into operation. A further refinement often included is to open a valve to atmosphere simultaneously so that clean air is drawn into the section in the reverse direction to the normal air flow, thus blowing the dust off the material. The shaking of the bag, and valve or damper operation is of course done by mechanical means, no manual operation being necessary.

The frequency of the cleaning cycle can either be pre-set to come into operation at pre-determined intervals or controlled by increase in pressure loss across the collector. (Fig. 9).

There are one or two points about the fabric collectors referred to. The first of these concerns the speed of air passing through them. The relationship between the size of dust carried in the air stream and the speed at which the air passes through the fabric is important. When very

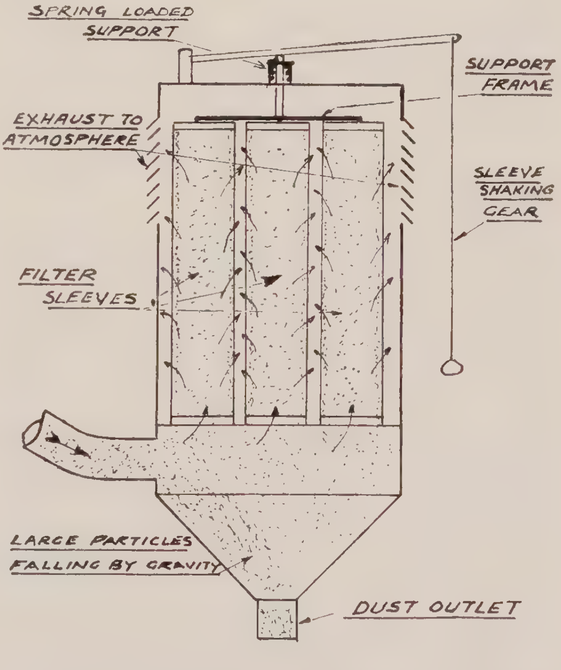


FIG 8 LAYOUT OF SIMPLE FABRIC SLEEVE COLLECTOR

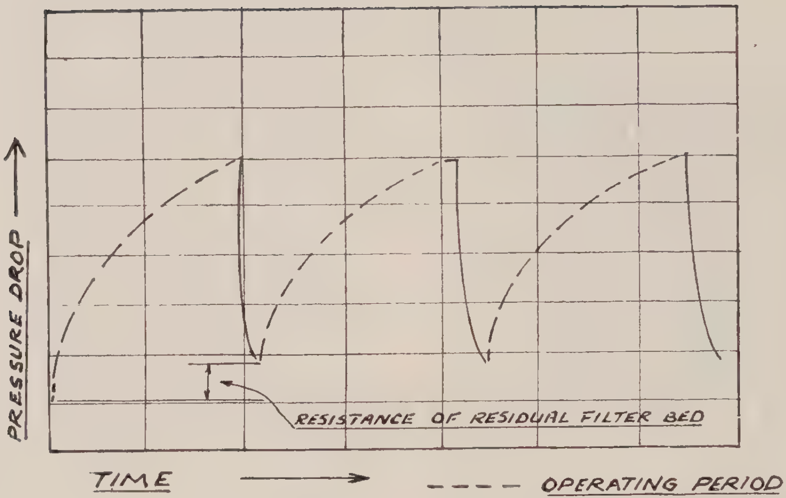


FIG 9 DIAGRAM OF OPERATION OF AUTOMATIC COLLECTOR.

fine dusts are to be collected this speed must be kept as low as possible. An extreme case is the collection of carbon black when the speed through the fabric is 1 cu. ft. per square foot of fabric per minute or more simply, the air passing through is only moving at a speed of 1 ft. per minute. Generally speaking, speeds up to 9 ft. per minute can be used, although modern practice shows that 6 ft. per minute is the most usual speed.

The question of volumetric flow must always be considered. The resistance of the collector to air flow increases as the dust builds up on the fabric matrix and if left uncleaned will gradually increase until the fan cannot overcome it and flow ceases. As this build-up is taking place, the volume is falling so that a bag collector is always working on a diminishing air flow.

When considering the cleaning of air by the use of fabric, the fabric to be used must be selected with care, taking into account the various conditions applying. Two conditions are most important: heat and humidity. When the air or gas to be cleaned is at high temperature, danger of destroying the fabric exists. For instance, wool can be safely used up to a temperature of about 120° C. but very rapidly deteriorates above it. Fortunately, synthetic materials such as terylene and nylon are available which extend the range of temperature still further up to about 300° C. These materials are expensive and also bring other difficulties into play.

Above the temperature of 300° C. no satisfactory answer has yet been found although experiments with various materials have been carried out.

Humidity in a fabric collector is a difficult problem. Air from drying processes and the like carries with it a large amount of water vapour and if the air is permitted to fall in temperature below its dew point, deposition of water on the fabric can and does take place with the result that all the interstices of the fabric block with wet dust and are difficult to clean. There are various methods of overcoming this state of affairs, but they are of necessity difficult and often expensive.

Turning now to the Reverse Jet Collector, this is a development of the bag collector which has recently come into more prominence. It differs basically from the ordinary bag filter in that the fabric is itself a true filter and is not dependent upon the build-up of a dust filter on its surface. The material from which the bag is made is a pure wool felt which by its construction forms the filter. Experiments have been made with synthetic filter fibres but as yet they are not in general use.

As this medium itself is very dense and does not permit easy passage of dust particles, however small, much higher air speeds through it are possible. Carbon black, which requires an air speed of 1 ft. per minute in the conventional type of bag collector can be satisfactorily removed from an air stream at 7-9 ft. per minute through the Reverse Jet Collector. Most dusts can be removed at a speed of 12-15 ft. per minute and in certain cases speeds of up to 30 ft. per minute have been used. (Fig. 10).

The cleaning of the bags in some cases is achieved by passing a hollow ring up and down the bags continuously. This ring has slots on the inside through which air at low pressure is blown. This air passing through the felt dislodges the adhering dust thus leaving the bag in a clean condition ready for use again. (Fig. 11). Provided that the speed of blow ring movement is correct, an almost constant pressure drop across the collector can be achieved, thus giving constant volume conditions. Like the normal bag collector, it suffers from disadvantages in hot or humid air conditions and for this reason discretion must be exercised before using such a unit.

(D) Wet Collectors

The wet type dust collection units basically depend on the dust being brought intimately in contact with water and then washed down in the form of a sludge or slurry. There are a number of types of such collectors available, all designed with the same principles in mind, but applying in different ways.

(*a*) *The Spray Chamber* (*Fig. 12*)

This design is basically dependent upon the individual dust particles colliding with water droplets produced through a series of spray points in the collector itself. To bring about the water/dust collision is by no means as easy as it would appear. The target efficiency of impingement can of course be calculated. It is apparent, however, that as there is a lot of free space within a spray, the likelihood of small particles in particular escaping entrainment is large. This is borne out in practice as particles less than 5 microns can seldom be brought down in a spray chamber.

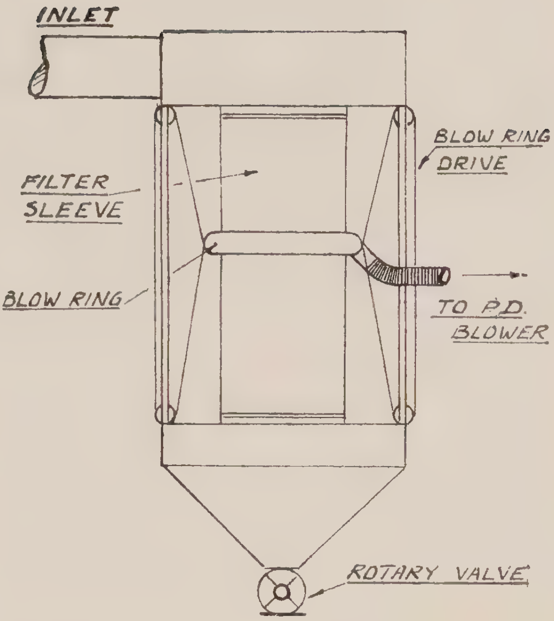


FIG 10 DIAGRAM OF REVERSE JET COLLECTOR

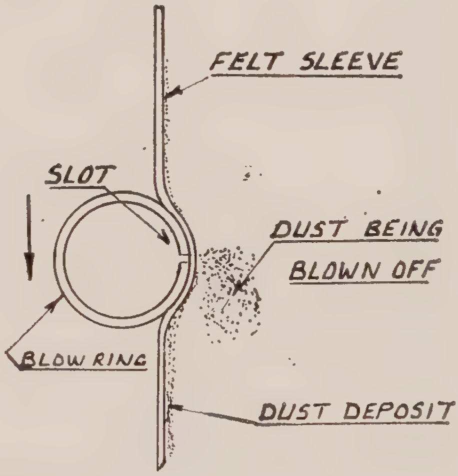


FIG 11 CLEANING METHOD OF BLOW RING TYPE OF REVERSE JET COLLECTOR

(*b*) *The Self-Induced Spray* (*Fig. 13*)

When air or gas is passed at high velocity through water there is a

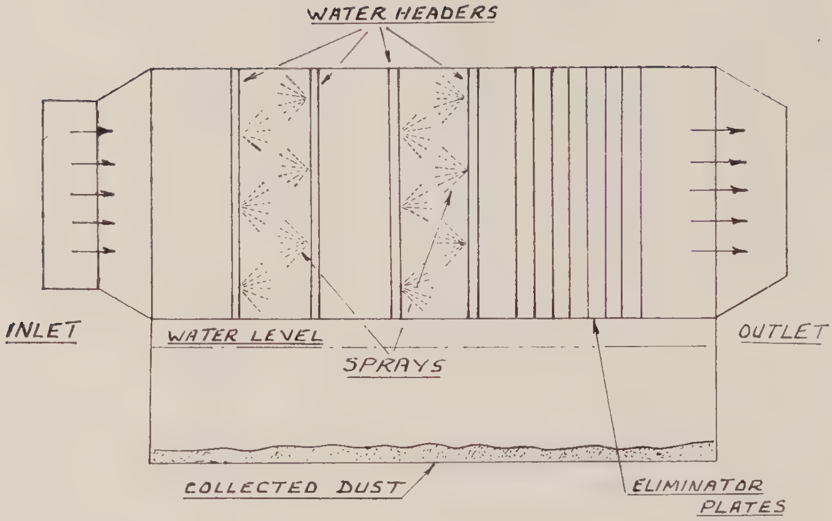


Fig 12 Spray Chamber Collector

tendency to break up the water itself into droplets the size of which depends on the speed at which the air " bursts " through the surface. By arranging the passage of dust-laden air so that it penetrates the water surface to a limited amount only, the velocity can be maintained at a fairly high level without imposing too high a pressure drop, with the result that the water is broken up into fine droplets which mix thoroughly with the air thus coming in intimate contact with the dust particles and increasing the chance of collision. The droplets are then permitted to fall back into the water. The self-induced spray collector therefore is similar to the spray chamber with the difference that in this case the spray is formed by the dust-laden air itself, thus increasing the chance of collision between particle and droplet.

(*c*) *Venturi Scrubber*

The venturi scrubber once more depends on the collision of finely divided water droplets with the individual dust particles. It will be appreciated that the difficulty lies in bringing about the collision of dust particles with the small droplets. The venturi type of collector achieves this by injecting water into a dust-laden air stream travelling at a very high velocity through a venturi throat thus breaking down the water into very fine droplets which are carried in this same air stream. The expansion from the venturi throat creates a turbulence in the air stream which thoroughly mixes the two. The loaded air stream is then usually passed into a centrifugal separator where the dust is brought down. Very high efficiencies are obtained using this system but the power consumption is very high indeed and running costs are therefore often prohibitive.

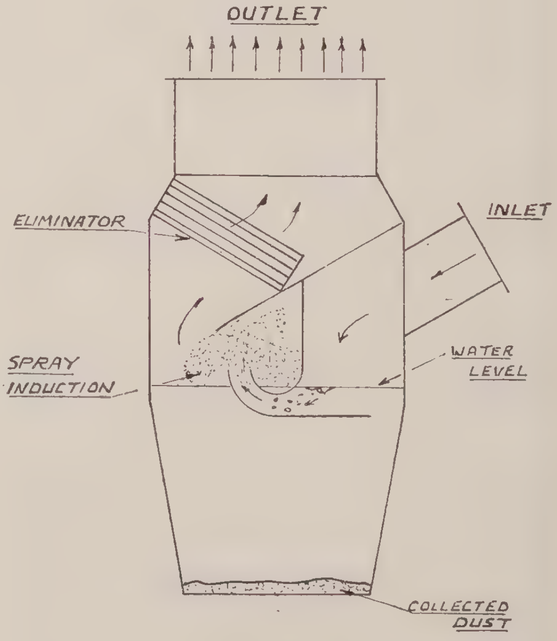


Fig 13 Self induced spray collector

(*d*) *The Disintegrator Scrubber*

As in the venturi scrubber this collector depends on the breaking down of water by mechanical means. The water in this instance passes through two sets of vanes, one set of which is stationary and the other set rotating at high speed. The water is thus broken down into minute droplets and intimately mixed with the dust. Once again final collection is usually in a centrifugal type of collector.

In designing wet dust collection plants so far the discussion has been concerned with those types which are wholly dependent on the division of water into droplets which mix with the dust thus increasing the individual particle size and/or its mass so that it will either settle more quickly or will be brought down in a centrifugal collector. It is proposed to discuss briefly a different principle of collection, that of impingement.

The Scrubbing Tower

The principle on which the scrubbing tower works is that of passing the dust-laden air upwards through a series of trays containing water. The dust-laden air is passed through bubble caps, so called because the air is forced to bubble through the water at each stage. Obviously by increasing the number of stages involved, the efficiency of collection will of course be increased. At the same time, however, the pressure loss across the collector will also be increased. The most difficult problem imposed, however, is that of cleaning the bubble trays themselves. Dust collecting in the trays is frequently difficult to wash out and settles, forming a sludge which has to be removed periodically.

A variation of this system is the use of the packed tower in which Raschig or Lessing rings are placed. These rings have a large surface area relative to their size which being wetted has a large capacity for retaining dust. Once again, difficulty is experienced in the removal of dust from these rings with the result that plugging of the tower takes place.

The pressure drop across packed columns is also very high.

There are two other types of impingement collectors in common use. One of these operates by allowing water to trickle down a series of plates against which the dust-laden air is directed. Dust coming in contact with the water is entrained and washed down into a settling tank from which it is periodically removed. This collector is dependent upon all the plate surface being wetted and at the same time a sufficient quantity of water passing over it to ensure that it is kept free of dust.

The Cascade type of collector has been developed to a high state of efficiency in this country. The dust-laden air is drawn through a series of cascades or water sheets formed between the collector casing and the tips of specially designed washplates. In this type of collector the water sheets are burst by the air stream. As the air velocity through the water sheets is relatively low, they are constantly re-forming so that the gas cleaning is very effective indeed. A specially designed kind of eliminator is employed to remove water droplets from the exhaust air. This type of plant is particularly popular in the quarrying industry and there are many such in operation in various parts of the country. (Fig. 14).

(E) Electro-static Precipitators

The final kind of collector which it is proposed to describe is the electro-static precipitator. These plants are used extensively in power stations for removal of grit and dust from flue gases and are becoming widely used in other industries where very finely divided dusts are entrained in a gas stream. Generally speaking, their efficiency of dust removal is very high, very often approaching 100 per cent. It must be pointed out that they, like all other collectors, have limitations.

The principle on which they operate is that the dust particles are passed through an electric field in which they receive a charge and are attracted to an electrode of the opposite charge placed in the gas stream. While the fundamental principle is fairly easy to understand, the reason for poor results in certain cases is still imperfectly understood. It has been suggested that the electrical resistivity of the dust particle has a considerable bearing on the matter. Authorities are somewhat at variance on this point however. For instance it has been stated that in order to be successful the resistivity of the dust should be below 2×10^{10} ohm./cm. but at the same time it has been found that carbon in the form of incompletely burned coal, soot or lampblack is extremely difficult to bring down.

There are two main kinds of electrostatic precipitator in use, the wire and plate type and the wire in tube type. There is little difference in the performance of these kinds, though claims are made for each.

It has been found by experience that an electro-static precipitator does not work satisfactorily on a heavily burdened air stream and therefore some pre-cleaner such as a cyclone should be incorporated in the system.

Generally speaking, these units are considered to be most efficient and certainly extremely high efficiencies are regularly obtained. The power consumption too is low as the pressure drop across such plants is usually of the order of only half an inch of water or so. The input of electricity for collection purposes is usually quite a low figure, often being about 2-2½ kW. It will be appreciated, therefore, that the actual running costs are reasonably low.

4. The Selection of Dust Collection Plant

When considering the installation of dust collection equipment a number of points must be taken into account. These are both financial and practical considerations. In those cases where the choice lies between two or more types of equipment, it is better to seek the advice of a specialist before making the final selection.

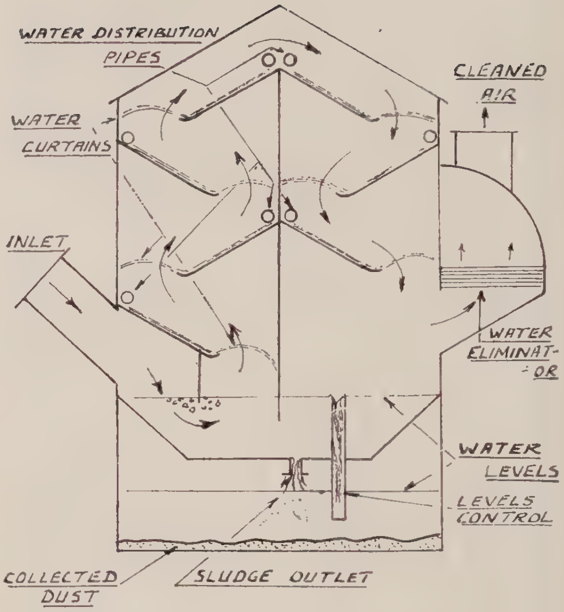


FIG 14 CASCADE TYPE COLLECTOR

When a plant is to be installed it is necessary to be clear for what reason the installation is to be made. This may on the face of it seem to be a superfluous question, but many manufacturers have found that in purchasing a collector to alleviate a nuisance, they have found themselves with a saleable product. For instance, in the quarrying industry, collectors have been installed to prevent a nuisance and the quarry owners have found themselves with an ideal filler for tarmacadam or some such purpose. It will be appreciated that under such circumstances the collector, far from being a nuisance, is a piece of productive plant.

The technical aspects must of course be very carefully studied. It is very easy for the layman, and indeed the specialist, to select the wrong type of equipment for a particular job. It was explained in the early section of this paper that certain technical details must be known before a selection can be made. In light of the descriptions since given, the reasons for this knowledge will become a little clearer. At least two steps in taking a decision on the type of plant to be used are necessary:—

Firstly, the type of dust to be dealt with and, secondly, the condition of the air or gas stream. For the purpose of simplification two tables have been prepared giving, in broad outline only, the various factors involved. (Figs. 15 and 16).

These factors, however, are themselves variable and only by a very close examination of the problem in question can a decision be arrived at. Power consumption, space available, heating sources, and so on, all have a direct or indirect effect upon the ultimate choice. Although an attempt has been made to explain the various aspects of dust collection in as simple a manner as possible, it is nevertheless a highly technical subject and to enter into the design and construction of such equipment without having investigated the various technical aspects involved is courting disaster. For example, the choice of fabric for a fabric collector is by no means as straightforward as it would appear, and only by having some knowledge of the dust concerned and the various fabrics available can a correct choice be made.

5. The Financial Aspect

This side of the subject is one that only too often is the deciding factor in the selection of dust collection plant, and also with few exceptions dust collection plants merely add to the overheads of a factory or works without any visible or tangible contribution to output. The invisible contributions made concern the improved working conditions within a workshop or factory, resulting in better health of operatives, the removal of dust from moving machinery which may damage bearings, machine slides, etc., and a reduction in cleaning costs of factory premises. These items, however, cannot be written down in terms of pounds, shillings and pence, and for this reason are frequently overlooked. Neglecting this side of the question, there are three aspects of the financial side which must be looked at with some care. These are the capital cost of the plant involved, its running cost, and its maintenance cost. These in turn must be related to the efficiency of collection of the plant involved. Obviously, a cyclone operating on a given dust with an efficiency of say 60 per cent is cheaper than an electrostatic precipitator whose efficiency on the same dust is 99 per cent. Again, it is fairly easy to build a plant to give an efficiency of 95 per cent on a given dust but it may cost as much again to build a plant to give 99 per cent efficiency on the same dust.

Few dust collection engineers care to forecast efficiencies without a very full knowledge of the site conditions and some prior experience on similar installations. It is just as well to remember that if a plant operates with a collection efficiency of 95 per cent it is discharging to atmosphere four times more dust than if it was working at 99 per cent efficiency, although on the face of it the difference is not very great.

A table has been prepared showing the relative costs of differing kinds of plant and from this table it is immediately clear that the cost of efficiency, generally speaking, is high in capital cost and total running cost. (Fig. 17). Just how this aspect is looked at depends essentially on the outlook of the management concerned, or perhaps it would be better to say their far-sightedness. (Fig. 18). Plant that is well designed and well constructed by experienced individuals, although being dearer on paper, may well prove to be the cheapest in the long run.

In conclusion may I make one point again—that industrial dust collection is the province of the specialist. The subject is much more involved than is immediately apparent and is itself an involved study.

TYPE OF COLLECTION PLANT

Contaminant in Air Stream					*FABRIC UNITS*					
	Settling Chamber	*Med. Effy. Cyclone*	*High Effy. Cyclone*	*Cellular Cyclone*	*Press Type*	*Suction Type*	*Auto. Type*	*Reverse Jet*	*Wet Collector*	*Electro-Static*
Grit	A	A	A	A	A	A	A	A	A	A
Dust Over 10μ	A	B	A	A	A	A	A	A	A	A
Fine Dust 5–10μ	C	C	B	A	A	A	A	A	A	A
Superfine Dust and Fume	C	C	C	C	A	A	A	A	B	A
Fibrous Dust	B	B	A	C	A	A	A	A	A	B
"Sticky" Dust	B	C	C	C	C	C	C	C	A	B

A – Satisfactory
B – Doubtful
C – Unsatisfactory

Fig. 15: Performance of Collectors on Various Types of Dust

Condition of Air Stream	*Settling Chamber*	*Med. Effy. Cyclone*	*High Effy. Cyclone*	*Cellular Cyclone*	*Fabric Collectors*	*Reverse Jet*	*Wet Collectors*	*Electro-static*
Temperature								
0 – 120°C	A	A	A	A	A	A	A	A
120 – 200°C	A	A	A	A	B	C	B	A
Over 200°C	A	A	A	A	C	C	C	A
Humidity								
Close to Dew Point	A	B	B	B	C	C	A	A
Saturated	A	B	B	C	C	C	A	A
Heavy Dust Load	A	A	A	C	C	A	B	C
Variation in Air Volume	C	C	C	A	A	A	A	A

A – Satisfactory
B – Doubtful
C – Unsatisfactory

Fig. 16: Performance of Collectors under Various Conditions of the Air Stream

Type of Plant	*Effcy. Per cent*	*Capital Cost*	*Power Cost*	*Water Cost*	*Maintenance Cost*	*Total Cost p.a.*	*Cost as Percentage of Capital*
Med. Effcy. Cyclone	65	1,400	120	—	40	160	11·4
High Effcy. Cyclone	75	2,100	155	—	40	195	9·3
Cell. Cyclone	81	2,300	168	—	61	229	9·9
Irr. Cyclone	97	2,900	196	35	160	391	13·4
Fabric (Cont.)	99	7,800	180	—	1,000	1,180	15·1
Rev. Jet	99·5	8,800	360	—	300	660	7·5
Self-Spray	94	3,200	228	70	180	478	14·9
Wet Impingement	96	7,000	360	90	180	630	9·0
Disintegrator	99·5	10,200	1,320	250	475	2,045	20·0
Venturi	99·8	10,500	780	300	225	1,305	12·4
Electro-Stat	99·9	12,600	84	—	350	414	3·2

Fig. 17 *Approx. Costs of* 10,000 *c.f.m. Dust Collection Plants*

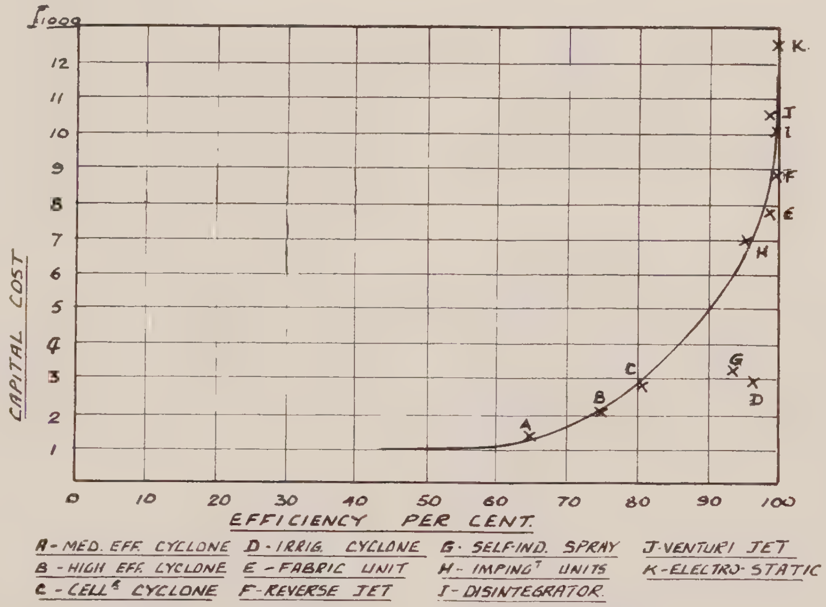


FIG. 18 COST/EFFY GRAPH FOR 10.000 C.F.M. COLLECTORS.

ADDENDUM TO MR. HODGSON'S PAPER

The following notes on factors affecting the standardization of measurement of dust in a gas stream are added to his paper following its presentation at the Conference.

Scope

There is some confusion on the question of standardization of methods used to describe the amount of dust present in a gas stream due to the various methods of measurement adopted even within industries concerned with the generation or control of dust.

An examination of the various ways of

describing dust concentrations has been made in an attempt to find some system which is universally acceptable or which is at least adaptable to the majority of those interested. It has been found that due to variance in the methods of describing air volumes it would be difficult to evolve such a system. The existing systems are described below.

Existing Systems

1. *British System* As a rule dust concentrations in those countries who do not use the decimal system for weights and measures adopt this method. It consists of stating the weight of dust (grains) in a given volume of gas (normally 1 cubic foot) and is so expressed i.e. grains per cubic foot.

This method is very useful as the grain (1/7000 lb) is a reasonably small measurement and therefore gives a measurement which is quickly appreciated. As all other measurements such as dust diameters are normally expressed in feet and inches calculations can be made without the necessity to carry out any conversions to other systems of measurement.

2. *Metric System* In those countries where decimal systems of weights and measures are used it is normal to adopt the system in which the dust concentration is specified in grammes per cubic metre.

This is once again perfectly acceptable for the same reasons as are specified above.

3. *Proportional System* This method is used frequently to denote the amount of contaminant in a gas stream and is usually expressed as parts per million or parts per hundred thousand. It is not normally employed to express solid contaminants but rather for gaseous contaminants such as SO_2 or H_2S. As it is not readily applicable to dust it is proposed to ignore it.

4. *Total Weight of Dust* Occasionally dust quantities are stated as a known weight in a given period e.g. 1000 lbs dust per hour. Even if the quantity of air is known it is dangerous to assume a steady dust concentration since experience has shown that rapid fluctuations can and do occur except in certain well defined cases. This method of dust measurement is therefore to be avoided.

Influencing Factors

It is unfortunate that both the British and the Metric Systems described above involve measurements of both weight and volume i.e. weight in the case of the dust, and volume in the case of the gas.

As the gas density varies according to both temperature and pressure it is therefore essential to state clearly under which conditions the gas volume is measured. This can be clarified if it is stated that the measurement is taken under some standard conditions. When the British System is in use the standard should be Standard Temperature and Pressure (S.T.P). This is 60°F, 30″ mercury and in the case of the Metric System, Normal Temperature and Pressure (N.T.P.) which is 0°C, 760 mm mercury. Unless some such standard is stated then ambiguity arises.

A further source of difficulty arises when the temperature or pressure does not conform to either of the standards given above. For example if a manufacturer states that on a rotary heating furnace a volume of 10,000 cfm air is required and that the outlet temperature is 400°F there is no indication at all whether the volume requirement is at S.T.P. (or N.T.P.) or at the elevated temperature. That manufacturer should state clearly the temperature at which the flow reading is taken or alternatively state the amount of air per minute as a weight. This puts the matter beyond doubt so far as air quantities are concerned. The dust quantities can then be stated as grammes of dust per pound of air or grammes of dust per kilogram of air.

Summary

1. It is felt that owing to relatively common use of British and Metric Systems of measurement it is advisable to retain their appropriate measurements of dust concentrations.
2. It would be desirable to express air quantities as weights rather than volumes.
3. When present systems are used it is advisable to state at what temperature and pressure the measurements are taken.
4. Care should be taken not to confuse British and Metric measurements including Fahrenheit and Centigrade temperature scales.
5. When the gas is other than air its density should be stated under conditions of known temperature and pressure.

CHIMNEY HEIGHTS—PROGRESS AND PROBLEMS SINCE THE MEMORANDUM

by

*S. C. Beaumont,**

M.I.Mar.E., M.R.S.H., M.A P H.I

ABSTRACT

The paper follows the progress of assessing chimney heights since the Clean Air Act, 1956 came into force. Efforts were made to arrive at some degree of uniformity by local authorities in the determination of adequate chimney heights in order to disperse chimney gases so that maximum ground level concentrations should be an acceptable minimum.

Reference is made to some of the problems for which it is considered the Clean Air Act and Memorandum do not provide an answer.

Progress

SECTION 10 of the Clean Air Act, 1956 provides that—

> (1) Where plans for the erection or extension of a building outside the administrative county of London, other than a building used or to be used wholly for one or more of the following purposes, that is to say as a residence or residences, or shop or shops, or an office or offices, are in accordance with building byelaws deposited with the local authority and the plans show that it is proposed to construct a chimney for carrying smoke, grit, dust or gases from the building, the local authority shall reject the plans unless they are satisfied that the height of the chimney as shown on the plans will be sufficient to prevent, so far as practicable, the smoke, grit, dust or gases from becoming prejudicial to health or a nuisance having regard to—
>
> (a) the purpose of the chimney;
>
> (b) the position and description of buildings near thereto;
>
> (c) the levels of the neighbouring ground; and
>
> (d) any other matters requiring consideration in the circumstances.
>
> (4) This section shall not apply to the erection or extension of a generating station as defined in the Electricity (Supply) Act, 1919, other than a private generating station as so defined.

The emission of smoke, grit, dust and gases from any chimney and the pollution of the atmosphere is the concern of the Public Health Department of all local authorities.

Although this Section of the Act may be delegated to Public Works Department, Building Surveyors, the task of interpreting the provisions of the Section and ensuring the proposed chimney heights were adequate, fall to the Public Health Inspector or Specialist Smoke Inspectors.

No guidance is given in the Act as to a minimum height of chimney apart from the requirement that the chimney height be sufficient to prevent as far as practicable smoke, grit, dust or gases becoming prejudicial to health or a nuisance.

This led to local authority officers having different opinions on what was an adequate chimney height and it appeared that no two local authorities officers appeared to have similar thoughts on what should be a suitable height for a proposed chimney to serve a similar fuel burning installation.

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* Chief Smoke Inspector, City of Birmingham.

The provisions of Section 10 of the Act undoubtedly caused difficulties for the local authorities and the industrialists. Officers of local authorities responsible for determining a satisfactory chimney height, when notifying Architects or Consultants of the authority's requirements would be met by the statement that another local authority required a chimney height considerably less than that now being asked, for a similar fuel burning installation.

It cannot be denied that there was a lack of uniformity in the method of arriving at what was considered to be an adequate chimney height, and chimney heights required by one authority bore no similarity to that required by another.

Some local authority officers made efforts(1) towards finding a method giving some degree of uniformity when considering chimney heights and turned to the use of the Sutton cold-gas formula as referred to in Appendix VI of the Report of the Committee on Air Pollution.

This formula provided means for determining the maximum ground level concentration of gases emitted from a chimney under normal meteorological conditions.

The dispersal rate of the gases will depend upon the chimney height and the wind velocity, but some gases will eventually reach ground level, and Sutton considered that the maximum concentration occurring at ground level would be at a distance from 10 to 15 times the height of the chimney.

Considering this formula, Mr. Ronald Williams, the late Chief Public Health Inspector of Coventry, produced a chart whereby the chimney heights for a given fuel usage could be determined.(2)

In 1959, Shell-Mex and B.P. Ltd., produced a modified version of Mr. Williams' chart, as being a reasonable and practicable method of determining basic chimney heights for industrial oil-fired installations until such time as official guidance became available; the chimney height being determined in relation to sulphur dioxide concentration at ground level. Shell-Mex and B.P. Ltd., acknowledged the work of Mr. Williams and indicated that their modified version of the chart was based on—

1. The Sutton cold-gas formula;
2. Industrial fuel oils of 200–3,500 seconds viscosity;
3. An average sulphur content for these oils of 3·0 per cent, and a specific gravity of 0·95;
4. A minimum basic chimney height of 30 feet for industrial oil burning equipment, however small;
5. The determination of the strength of SO_2 source by reference to the average hourly oil consumption over a 24 hour period of heaviest envisaged load;
6. A wind speed of 10 feet per second.

Three lines were plotted on the chart whereby a required chimney height could be directly found against the average hourly consumption of oil fuel in gallons over a 24 hour period of heaviest envisaged load. (Fig. 1).

The three lines referred to on the chart represented "White", "Grey" and "Black" areas. "White Areas" being semi-rural and rural areas, with little or no industrial development and virtually no background pollution. "Grey Areas" being areas with some industrial development, but where such development is not dense, and "Black Areas" being those highly industrialized areas in which background pollution from all sources already exists.

Obviously it is desirable to avoid as far as possible, increasing the pollution in areas already subject to a relatively high level of air pollution. Accordingly, having regard to the emission of SO_2 the accepted maximum ground level concentrations were as follows—

25 parts per hundred million for "Black Areas"

30 parts per hundred million for "Grey Areas"

35 parts per hundred million for "White Areas".

This meant that an oil-fuel burning installation would require a greater chimney height in a "Black Area" than if installed in a "White" or "Grey".

An example from the chart is as follows—For an average consumption of 100 gallons per hour the required chimney height would be 77½ feet in a "White Area", 83½ feet in a "Grey Area", and 92 feet in a "Black Area." Other factors, such as the height of adjacent buildings and the levels of the neighbouring ground would also be considered.

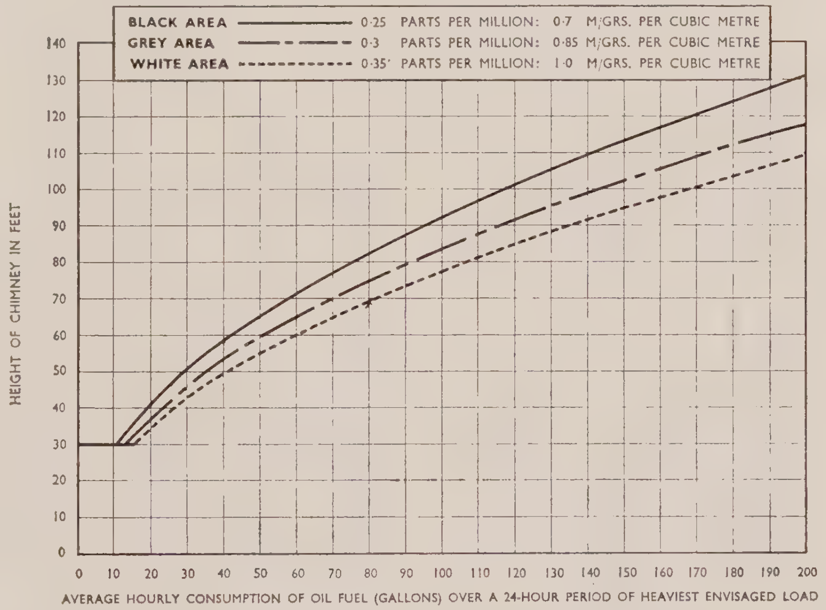
There is no doubt that the chart issued by Shell-Mex and B.P. Ltd., was most useful and of assistance to officers of local authorities in arriving at a suitable chimney height for oil-fired installations, based, of course, on the Sutton Formula.

Industry too was concerned about the difficulties in assessing chimney heights that would be acceptable to the local authorities, and although the Chart already referred to was useful for determining chimney heights this was applicable for oil-fired installations only and it was therefore necessary to consider other types of fuels.

The Federation of British Industries set up a Working Party to look into the problem and to make recommendations on the heights of chimneys with particular reference to Section 10 of the Clean Air Act.

CHIMNEY HEIGHT IN RELATION TO SULPHUR DIOXIDE CONCENTRATION AT GROUND LEVEL

This provisional chart is put forward as a reasonable and practical method of determining basic chimney heights for industrial oil-fired installations until such time as official guidance becomes available. It is a modified version of a chart by Mr. Ronald Williams, Chief Public Health Inspector of the City of Coventry, and acknowledgements are made to him and to 'The Municipal Journal' in which his chart was first published.



The chart is based on:—

1 The Sutton cold-gas formula (Beaver report Appendix 6).
2 Industrial fuel oils of 200-3500 seconds viscosity Redwood No. 1 @ 100°F.
3 A weighted average sulphur content for these oils of 3.0 per cent., and a specific gravity of 0.95, which are typical of the fuels marketed in the United Kingdom.
4 A minimum basic chimney height of 30 ft. for industrial oil burning equipment, however small.
5 The determination of the strength of SO_2 source by reference to the average hourly oil consumption over a 24 hour period of heaviest envisaged load.
6 A wind speed of 10 ft./second.

If the foregoing bases are taken, the Sutton cold-gas formula reduces to:—

Black Areas $h = 9.21\sqrt{c}$
Grey Areas $h = 8.36\sqrt{c}$
White Areas $h = 7.71\sqrt{c}$

Where: h = chimney height in feet, c = average hourly oil consumption over a 24 hour period of heaviest envisaged load.
The above graphs are plotted from these equations.

Information on how the chart is used is given on the back of this card.

SHELL-MEX AND B.P. LTD., FUEL OIL DEPARTMENT
September 1959

Fig. 1

In June 1961 the Federation produced a booklet$^{(3)}$ on the recommendation of the Working Party, and which proved a useful guide to both industry and local authorities.

The recommendations were grouped—

1. General recommendations on chimney design—applicable to all classes of plant.
2. Recommendations for the height of chimneys for small industrial boiler plant.
3. General recommendations on chimneys for large commercial buildings.
4. Recommendations for estimating chimey heights required in relation to acceptable ground level concentrations of sulphur dioxide.
5. Recommendations on control of grit and dust.

The Working Party's main recommendations refer to industrial boiler plants having a maximum continuous rating of 5,000–33,000 lb/hr. steam.

The booklet included a Table and a Graph giving recommended heights for certain size of boiler plant. The slope of the curve on the graph was such as to give a theoretically constant low maximum ground-level concentration of SO_2 and rate of dust deposit, subject to the acceptable figures given for SO_2 and dust. (Fig. 2).

A paper incorporating these recommendations was presented to the Institute of Fuel in London, by Mr. G. Nonhebel, before the general release of the details. It was very favourably received, and when published in booklet form served to assist officers of local authorities in reaching some degree of uniformity, when determining chimney heights. It also gave industry information on what heights of chimneys local authorities were likely to accept.

The Minister of Housing and Local Government was aware of these efforts, and that some positive guidance for local authorities was necessary in regard to Section 10 of the Act. Consequently a Ministry Working Party was formed to consider this problem.

It had been represented to the Minister that a simpler form of guidance would assist local authorities in the exercise of their functions with regard to chimney heights and the provisions of Section 10 of the Clean Air Act. With this in view the Working Party completed its work and the Memorandum on Chimney Heights was issued by the Ministry of Housing and Local Government, as being a relatively simple method of calculating the approximate chimney height desirable under normal circumstances.

Table 1: Recommended height for chimneys for small industrial boiler plants

Maximum continuous rating of boiler plant (excluding overloads of short duration)	Minimum Chimney height*	Approximate flue gas rate at S.T.P. (60°F, 15°C and 1 atm. pressure)
1,000 lb/hr steam or million Btu/hr	Ft.	1,000 cu. ft/min
Under 5	60	Below 2
Over 5 and under 12	80	2—5
Over 12 and under 21	100	5—8
Over 21 and under 33	120	8—13
Over 33	Over 120 or 2½ times height of adjacent building, which ever is the greater.	

* 5—10 ft. should be added to these heights if the velocity of the gases at the chimney mouth is below 20 ft/sec at maximum continuous rating to avoid serious downwash—see page 7).

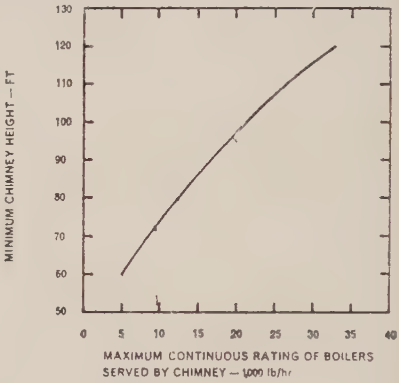


Fig. 2

The Memorandum on Chimney Heights indicates that the method of calculation is to be regarded as a guide rather than a mathematically precise way of reaching a decision on chimney height. Obviously other factors, such as the nearness of tall buildings and levels of the neighbouring ground must be considered. The Memorandum is not applicable to all chimneys, but applicable only to—

(*a*) Chimneys of industrial boiler plant of maximum continuous rating greater than approximately 650 pounds of steam per hour and not exceeding 450,000 pounds of steam per hour; or

(*b*) Chimneys serving furnaces burning fuel at a maximum rate greater than approximately 100 pounds of coal per hour, or 50 pounds of oil per hour, and not exceeding 50,000 pounds of coal per hour or 30,000 pounds of oil per hour.

The calculated chimney height is directly related to the maximum emission of sulphur dioxide per hour.

The amount of sulphur dioxide emitted per hour is calculated from 18 W.S. lb/hr. when burning coal and 20 W.S. lb/hr. when burning oil. The lower figure for coal takes into account that some 10 per cent of the sulphur in coal is retained in the ash.

The maximum rate at which the fuel is burnt is W thousand pounds per hour, whilst S is the percentage sulphur content in the fuel.

The Memorandum points out that the diameter of the chimney top should be as small as possible in order to increase the efflux velocity of the flue gases. If the efflux velocity is insufficient the plume of gas tends to flow down the outside of the stack on the lee side and the effective chimney height is reduced.

It is considered that efflux velocities of about 50 feet per second will avoid this down wash.

It is realized that such a velocity is impracticable for small boilers but boilers equipped with forced draught fans should have a chimney efflux velocity of not less than 20 feet per second at full load. Boilers equipped with induced draught fans should have an efflux velocity of not less than 25 feet per second at full load for boilers rated up to 30,000 lb/hr. increasing to a maximum of 50 feet per second at full load for boilers up to 450,000 lb/hr.

The method of calculation assumes that the appropriate efflux velocity will be achieved and the Memorandum indicates that prejudice to health or a nuisance from smoke, grit and dust should not occur where the chimney heights are calculated in accordance with the method indicated having regard to the other relevant provisions of the Clean Air Act.

It should be noted that in the calculation of the uncorrected Chimney Height, this should never be less than 40 feet. The method of calculating chimney heights is simple.

The Memorandum contains four charts for finding the uncorrected height of chimneys for (*a*) very small installations; (*b*) small installations; (*c*) medium installations; (*d*) large installations.

Very small installation being those having a sulphur dioxide emission of from 0–30 lb/hr.; small installations 30–100 lb/hr.; medium installations 100–400 lb/hr.; and large installations 400–1,800 lb/hr.

Consideration is also given to the character of the surrounding district and five categories are given—

A. An undeveloped area where development is unlikely, where background pollution is low, and where there is no development within half a mile of the new chimney.
B. A partially developed area with scattered houses, low background pollution and no other comparable industrial emissions within a quarter of a mile of the new chimney.
C. A built-up residential area with only moderate background pollution and without comparable industrial emissions.
D. An urban area of mixed industrial and residential development, with considerable background pollution and other comparable industrial emissions within a quarter of a mile of the new chimney.
E. A large city or an urban area of mixed heavy industrial and dense residential development with severe background pollution.

There is no doubt that the method of determining the chimney height is simple enough.

Having arrived at the weight of the sulphur dioxide likely to be emitted and placed the district in which the plant is to be installed in its appropriate category reference is then made to the charts.

To find the uncorrected height a line is taken from the left hand side of the chart representing the SO_2 emission in lb/hr., through a point representing the category into which the district falls, and directly across to a vertical line on the right side of the chart, which represents the chimney height in feet.

Having determined the uncorrected height, the chart giving the final chimney height is now used.

On the left hand side a vertical line indicates the uncorrected height from where a line is drawn directly through a point representing the building height, to a reference line. From this reference line, a line is taken passing through a point representing the building height or length, whichever is the lower, to a vertical line on the right hand side of the chart, representing the final chimney height.

The Memorandum was received by officers of the local authorities with approbation; it was something that had been talked about, something that many local authorities considered was needed. It provides that degree of uniformity in assessing chimney heights, and being a Ministry publication carried more weight than the other methods of assessing chimney heights.

The Memorandum covers installations burning liquid and solid fuels and considers that the minimum chimney height should not be less than 40 feet, as against 30 feet on the chart produced by Shell-Mex and B.P. Ltd.

The chimney heights calculated by the use of the Memorandum takes into account the actual sulphur content of the oil and its specific gravity and having regard to the category of the district, the heights of chimneys calculated are generally higher than those given on the Shell-Mex and B.P. Ltd., Chart.

On the other hand it would appear that the heights produced by the Memorandum are generally lower than the heights recommended by the Federation of British Industries.

Having regard to the difficulties that had been experienced in satisfying the various persons concerned with chimney heights the local authorities welcomed the Memorandum as here was a method of arriving at an adequate chimney height approved by the Ministry of Housing and Local Government.

Architects were concerned with the appearance of a building, the owner was concerned with cost and had no desire to put up a higher chimney than absolutely necessary, but the local authority officer responsible for chimney heights felt he was now able to say with authority that the chimney height he had calculated was in accordance with the Memorandum on Chimney Heights and he had no reason to consider there was any doubt why such a height was necessary.

More and more high sulphur content fuels are being used and consequently the emission of sulphur dioxide has greatly increased. There can be no doubt that the upper atmosphere must have a greater concentration but as far as the writer is aware there are no reports of any significant increase in the maximum ground level concentration of sulphur dioxide.

This being so then a policy of higher chimneys is justified.

Problems

Local authorities are concerned with air pollution and must make every effort to ensure that the pollution is a minimum, and although the Memorandum on Chimney Heights was welcomed by most local authorities not all persons concerned with chimneys and fuel burning plant feel completely satisfied with the method and certain conditions arise from time to time that add to the problem of the adequate dispersal of chimney gases.

Some Architects do not appear to be fully aware of the Memorandum as plans submitted to the Planning Authority and Building Surveyors frequently indicate chimney heights that obviously have not been calculated in accordance with the Memorandum. Others, however, will contact the Public Health Officer and discuss the required chimney height before plans are officially submitted. This procedure is to be welcomed as both parties are satisfied, and undue delays in dealing with plans are avoided.

In the City of Birmingham there is a cordial liaison between the Health Department and the Planning Department and little difficulties are experienced in agreeing on chimney heights, but it would appear that generally Planning Authorities do not look with favour on high chimneys.

Section 10 of the Clean Air Act applies to new chimneys but does not apply to chimneys of dwellings, offices or shops. Considering the heating plants in the new multi-storey offices and shops, which are equal or greater in size than many of the small industrial type plants it is difficult to appreciate the reason why these chimneys should not be included in the provisions of the Section.

The Memorandum in conjunction with Section 10 of the Act does not cover all contingencies that arise with regard to fuel burning plant and chimneys. The following examples are given—

A coal burning industrial plant has been operating for some years. The owner, due to various circumstances, decides to change to the use of liquid fuel and installs an oil-fired system. Having regard to the Memorandum and the type of oil in use, the existing chimney may be very much lower than would be required if a new chimney was to be erected. The owner is not required to notify the local authority of the change of fuel, and the local authority has no powers to require the chimney to be raised to a suitable height in accordance with the Memorandum. Again, what is to prevent any person submitting details of a proposed heating plant indicating that coal is to be the fuel in use. A chimney is agreed and approval given. Before the installation is put into service the owner apparently can change his mind and use oil in place of coal. The chimney has already been erected, and it would appear that the local authority can do nothing to require the chimney to be raised.

It is possible too that an oil fuel plant is to be installed for the purpose of burning say 200 seconds viscosity oil. The owner submits details in good faith, but within a short time of operating he is aware that heavy oil is cheaper, and changes to the use of this oil. Having regard to the sulphur content of the oil the chimney height may now be inadequate. The local authority will have no means of knowing that a change of fuel has taken place, and even if aware of a change has little hope of persuading the user to raise the chimney height accordingly.

Section 10 (1) states that ". . . the local authority shall reject the plans unless they are satisfied that the height of the chimney as shown on the plans will be sufficient to prevent, as far as practicable, the smoke, grit, dust or gases from becoming prejudicial to health or a nuisance."

In the case referred to, the plans will already have been approved and the chimney erected, and therefore it would appear that no further action could be taken.

If nuisance occurred from fumes or smoke other than dark smoke then it may be possible to take necessary action under 92 (*d*) of the Public Health Act, 1936 or Section 16 of the Clean Air Act, 1956.

Could the remedy be stated in the Abatement Notice "Increase the height of the chimney by X feet", and would a Magistrate consider the interpretation of "practicable" in accordance with Section 34 of the Act?, ("Practicable" means reasonably practicable having regard among other things, to local conditions and circumstances, to the financial implications, and to the current state of technical knowledge,") to the advantage of the Corporation? It remains to be seen.

The photograph Fig. III indicates another problem that arises in this age of multi-storey premises. Here can be seen a chimney that is dwarfed by a newly erected tall building erected within approximately 20 feet and it is difficult to see how some of the occupants of a high building can fail to be affected by combustion gases from a relatively low stack in such circumstances.

Section 28 of the Public Health Act, 1961 recognizes the effect on the chimney of an existing building, when a taller building is erected close to the existing lower building. The Act provides that—

(*a*) Where any person erects or raises a building to a greater height than an adjoining building, and

(*b*) Any chimney or flues of an adjoining building are on a party wall between the two buildings or are six feet or less from the nearest part of the latter building,

The local authority may by notice—

1. Require that person, within such time as may be specified in the notice, to build up those chimneys and flues, if it is reasonably practicable so to do, so that the top thereof will be the same height as the top of the chimneys of the latter building, or the top of the taller building, whichever is the higher.

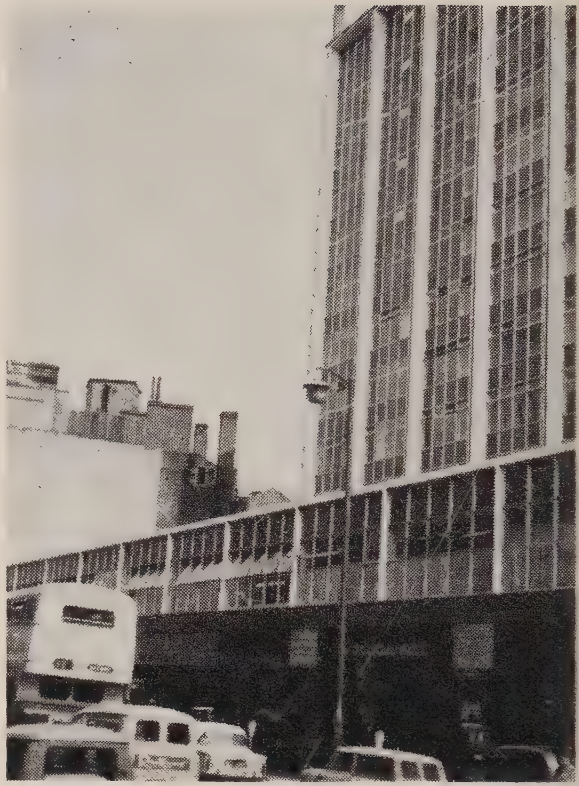
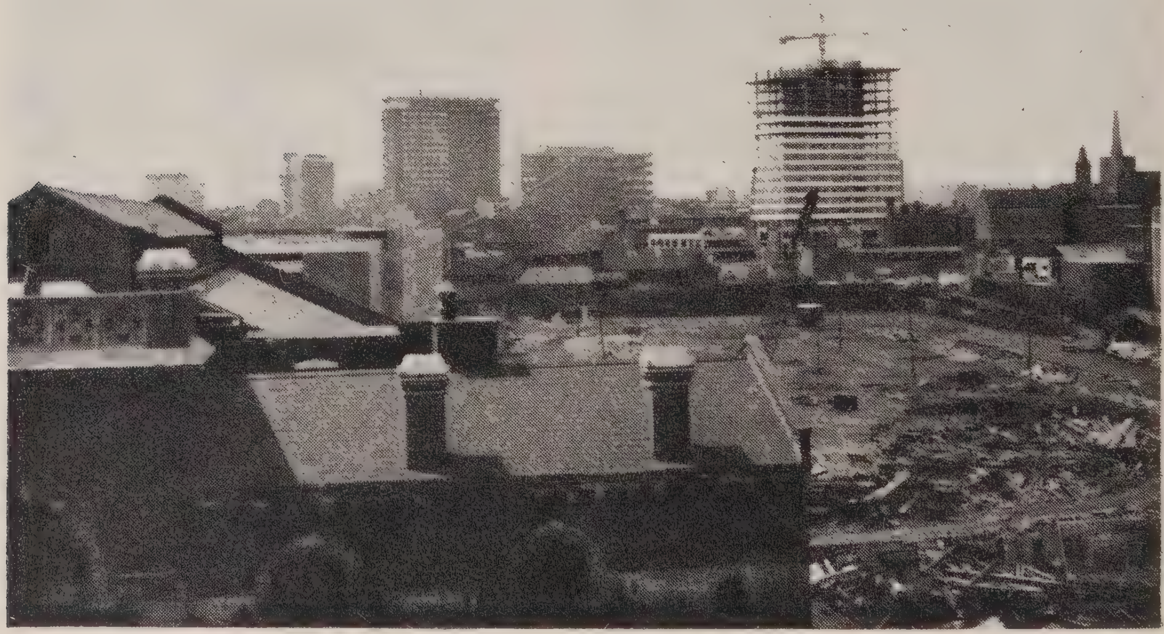


Fig. 3

This does not help where the chimney of the lower building is more than six feet away, and in many cases it may not be practicable to raise the height of the chimney. The onus is upon the person concerned not to cause nuisance by reason of emissions from the chimney, and it seems hard that he will be faced with the cost of increasing the chimney height if this becomes necessary.

More and more multi-storey buildings are being erected in our cities and these too are presenting a problem. The photograph Fig. IV shows a number of multi-storey office blocks,

Fig. 4



the two taller blocks now under construction, whilst the middle lower block has been completed approximately two years ago. This building has an oil fired heating installation, and the chimney height was quite adequate to ensure dispersal of the combustion gases. Two new buildings, which are quite a lot higher are built approximately 150 years on either side of the low building, the path of the prevailing wind being from one tall building to the other. This is likely to mean for the greater part of the year the gases from the lower building will be directed towards the right-hand taller building, whilst the taller building to the left is almost certain to create conditions that on occasion will cause a down draught in the area of the lower building.

With large fuel burning plant the erection of tall blocks of flats and other buildings in the near vicinity could mean that the occupants of the tall buildings may be subjected to a heavily polluted atmosphere for continued periods. The erection of such tall buildings could also adversely affect the normal dispersal of the chimney gases by reason of down draught conditions, and where high sulphur content fuels are in use, the occupants of the tall buildings in the area could be living in an atmosphere having an undesirably high sulphur dioxide concentration.

It would be impracticable to strike a line from the top of the chimney and reaching ground level at about fifteen times the chimney height where maximum ground level concentration occurs, and prohibit the erection of buildings where the height would be above the line as indicated in Fig. V.

Nevertheless, particularly where chimneys serve large fuel burning plants, this is a problem that the Town Planning Authorities will have to face.

Reference has already been made to the effect that on occasion architects submit plans where it is evident that the chimney required to serve a furnace or heating plant has not been considered in relation to either Section 10 of the Clean Air Act or the Memorandum on Chimney Heights.

The photograph Fig. VI illustrates an example of this, and refers to a single-storey school building, bounded on two sides by three-storey and six-storey flats, and including two blocks of eleven-storey flats.

The flats are electrically heated and it seemed strangely illogical to erect a school building, and to propose a mechanically fired coal burning installation for the purpose of heating the building. The left foreground of the photograph shows part of the eleven-storey block of flats approximately 80 feet from the school building, in the path of the prevailing wind; the proposed chimney height was 18 feet. Objection was made to such an installation and it was suggested that in view of the dwellings being all electric that here was a case for heating the school by the same means. Unfortunately, the Ministry concerned would not approve electric heating for schools and a compromise was accepted in that gas heating should be installed.

The Town Planning Authorities have no easy task and it is difficult for them to foresee the problems that may arise in city development.

The photograph Fig. VII shows multi-storey flats in an area of

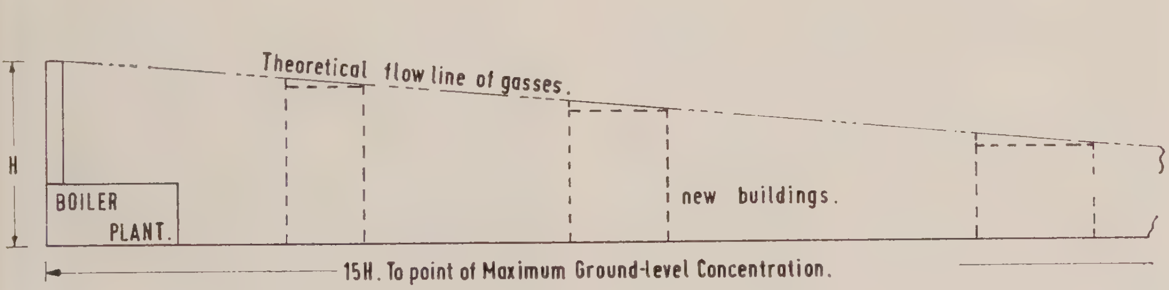

Theoretical flow line of gasses.
H
BOILER PLANT.
new buildings.
15H. To point of Maximum Ground-level Concentration.

Fig. 5

Fig. 6

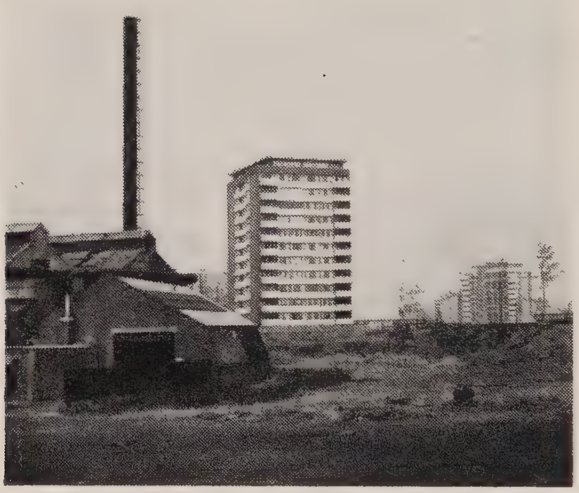


Fig. 7

considerable industry. The chimney shown serves non-ferrous scrap melting furnaces, the processes coming under the control of the Alkali Inspectorate. Before the flats were erected, complaints of fumes were being received, and the Alkali Inspector prevailed upon the firm to increase the chimney height from 60 feet to 120 feet. Unfortunately within a few months the Corporation erected, as can be seen, a block of multi-storey flats in fairly close proximity to the works, the flats being approximately the same height as the chimney. Under certain wind direction conditions the emission of smoke and fumes affects the upper storeys of the building. Here again difficulties arise; the chimney foundations will not permit any worthwhile extension of the chimney, and no doubt the Company would be aggrieved if compelled to increase the chimney height. Every effort is made by the firm to keep emissions to a minimum, and thoughts have been given to means of a fume arrestment plan, but there is also some doubt as to the continuance of the processes in these works. The local authority has no jurisdiction over such works and will notify the Alkali Inspector if and when any nuisance occurs, but this is an instance when good planning is required and consideration given to chimney emissions and to the maximum height of flats to avoid nuisance.

Tall chimneys are necessary to ensure adequate dispersal of chimney gases, particularly where a high sulphur dioxide concentration is to be avoided, but these too lead to problems. The greatest heat loss in a boiler plant is by way of the chimney, and therefore the higher the temperature of the exit gases then the lower is the efficiency of the plant.

The writer was told on one occasion by a Works Engineer "We try to improve efficiency of oil-fired plant by keeping the chimney temperature down, but the Public Health Inspectors insist on a high chimney which tends to further cool the gases to below the acid dew point temperature, causing condensation and the emission of acidic smuts." This of course is one of the difficulties when burning oil, particularly where steel chimneys are used, although one of the most serious emissions of "acidic smut" emission in the City of Birmingham was from a brick built chimney in the centre of a large block of offices. To prevent such an occurrence it is necessary that the exit gases be maintained at a temperature that will ensure condensation will not occur. Can the local authority insist on a guaranteed chimney temperature, or insist on the cladding of the steel chimney so as to prevent undue cooling of the gases?

With many smaller plants the velocities of chimney gases as suggested in the Memorandum is not always achieved and the low efflux velocity may result in "down wash" occurring. One successful method to increase the efflux velocity and avoid down wash is by the use of carefully designed venturi caps at the chimney top. Can the local authority inspector, when recommending a chimney height in accordance with the Memorandum for small natural draught installations, insist on the chimneys being fitted with venturi caps so as to ensure the efflux velocity is in accordance with the Memorandum?

Conclusions

Much has been done to reduce the visible pollution of the atmosphere, and efforts must continue to endeavour to reduce pollution from sulphur dioxide. Tall chimneys apparently are the present answer but the producers of high sulphur content fuels must keep this problem in mind, as the best remedy towards reducing sulphur dioxide emissions is the use of low sulphur content fuels.

The reduction in the numbers of chimneys would also do much to improve matters and the promotion of district heating schemes would tend to reduce the numbers of chimneys and pollution.

Large numbers of dwellings are now being erected without chimneys, this being one method whereby low level concentrations of sulphur dioxide may be reduced.

The problems given are real, not hypothetical; consideration should be given towards means to avoid unnecessary risk of nuisance from chimney gases, particularly where a change of use of fuel means that the emission of sulphur dioxide is such that the chimney should be higher to ensure adequate dispersal of the gases.

The City of Birmingham, like many other cities, is becoming a city of sky scrapers. Parts of the city with its high buildings are free from visible pollution, but concern is still felt about the effects of sulphur dioxide and trioxide in the atmosphere. Is the atmosphere at the level of the top of the taller buildings much greater in sulphur dioxide concentration than at ground level, and will this have any adverse effect on the buildings and occupants?

The Memorandum on Chimney Heights has resulted in uniformity of approach and has ensured adequate chimney heights; adherence to the guidance given, in conjunction with Section 10 of the Act will result in the dispersal of combustion gases without creating nuisance.

Problems still remain to be solved, but in spite of this the Memorandum has, in general, proved its worth.

REFERENCES

1. Memorandum on the Miscellaneous Provisions of the Clean Air Act, 1956—Paragraph 16.
2. R. Williams—"Chimney Heights and Pollution—A New Ready Reckoner", Municipal Journal, June 1959.
3. Height and Design of New Chimneys—Federation of British Industries.

Discussion

Dr. G. Nonhebel (Individual Member) opening the discussion, referred first to Mr. Hodgson's paper. He congratulated the author on the useful tables on page 160. Nevertheless he deprecated strongly the expression of performance of dust collection plants in terms of percentage efficiency of collection. It was better to give the percentage "slip". Thus 98 and 99 per cent efficiency both seemed excellent, but the escape of dust with 98 per cent was double that with 99 per cent efficiency. The Alkali Inspectorate went further for some processes and required an emission not exceeding a stated amount, e.g. 0.05 gr/ft^3 s.t.p. from oxygen-using steel furnaces. Recommendations on dust and grit emissions from boiler plant recently formulated by a working party recommended by the Clean Air Council were now under consideration by the Ministry of Housing and Local Government.

Referring to the table on costs on page 161, Dr. Nonhebel asked whether the capital costs included foundations, flues and other ancillaries. In his experience these could double the cost of the more complicated plant. On descriptions of dusts, page 148, he preferred a further subdivision for particles smaller than 10 microns, namely fine dust all smaller than 5 microns and fume, condensed material, all less than 1 micron. Fume had quite different surface characteristics and readily aggregated to chains of particles. For the removal of ultra-fine dusts and fumes to the standards required for manufacture of bio-chemicals, fine instruments and certain radioactive materials, it was necessary to use quite a different form of filter as a "polisher" after conventional dust arresters—see *High Efficiency Air Filtration* by P. A. F. White and S. E. Smith (Butterworth, 1964). The best filter medium so far developed was a form of paper made from glass fibres.

An aspect of design not mentioned by Mr. Hodgson was the provision of devices to ensure even distribution of the dust burden to the inlet of the collectors.

Many plants had not given expected performance because the dedusting problem had not been put fully to the manufacturers by the purchasers, or neither side had asked the right questions of each other when design was being worked out; for example variations during the cycle of operation day and night in terms of analysis, external temperature, etc.

Plant performance frequently deteriorated without the knowledge of the operating staff through incorrect operation or the need for maintenance. Dr. Nonhebel suggested that a paper be given at the next conference on monitoring devices for all classes of dust collecting plant.

Referring to Mr. Beaumont's paper, Dr. Nonhebel said that objectors to high chimneys usually ignored the serious effects of downdraughts of flue gas caused by the wind passing over adjacent high buildings. Architects seemed unaware of the information obtainable by simple wind-tunnel experiments. As regarded flue gas disposal from large high commercial buildings and flats, the gases could be induced to flow away without being carried down the side of the building by suitable design of roof. Thus designs for the roofs of Shell Centre, Waterloo, London, and Churchill College, Cambridge, had been evolved with the aid of wind tunnels.

Another reason for high factory chimneys irrespective of height of adjacent buildings was that looping of the plume caused by rising warm air was reduced. He had observed this effect the past summer among a group of chimneys varying from 150 to 200 feet attached to process plant only 30 feet high; only the plume from the 200 feet chimney was free from looping.

Critics of combination of effluents to single high chimneys (page 173) seemed unaware of the modern practice of subdividing the stack into several flues so that effluent velocity was maintained at low loads. The stack should still be kept slim and not be a tower as proposed by an architect for Washington, Co. Durham (see Fig. 2 on page 128). The difficulty illustrated by Fig. 7 of Mr. Beaumont's paper could only be resolved by segregating high flats and all industry requiring chimneys. Planning authorities as well as architects had to face up to the fact that heavy industry and high residential accommodation could not be mixed whatever changes occurred in the supply and quality of heating fuels in the future.

R. A. Newton (Lambeth) drew attention to the fact that neither Section 10 of the Act, nor the Memorandum, referred to London. This resulted in a losing battle between the Smoke Inspector and the designing architect and the Planning Office.

It was perhaps not surprising that the SO_2 content of London's air was considerably higher than everywhere else.

R. A. Pullen (The Park Gate Iron and Steel Co. Ltd.) thought that in Mr. Hodgson's discussion of the methods of industrial dust cleaning he had failed to mention a very vital aspect of all methods involving wet collectors. That was the inversion that invariably happened at the top of the stack due to water vapour present in the waste gases when they passed through a wet precipitator. In view of the need to conserve heat in the plume, so that the waste gases' buoyancy could assist dispersion, the use of wet washing methods should not be encouraged, in particular on emissions containing sulphur dioxide and other noxious gases. They were now accepting the fact that high ground level concentrations of the oxides of nitrogen were also a health hazard. In view of those facts, would Mr. Hodgson say whether he felt that wet washing methods should now be openly discouraged?

P. Draper (Individual Member) agreed with Mr. Beaumont's survey of the early efforts to provide a guide to chimney heights and his finding that the Ministry *Memorandum on Chimney Heights* was reasonable technically and had the great advantage of being official. He suggested that the author might emphasize this aspect by adding the memorandum title to his bibliography so that the architects to whom he referred might find it more easily.

He thought, however, that there were several items in the Memorandum which needed to be cleared up in future editions. He stressed the importance of high flue gas exit velocity but found it was not covered adequately, 50 ft. per sec. was correctly given as the velocity necessary to avoid down-wash yet 20 to 25 ft. per sec. was condoned for some medium-sized boilers.

S. A. Eade (Harlow) referred to the inadequacies of the Clean Air Act mentioned by Mr. Beaumont in his paper, particularly in regard to those chimneys which existed before the Act came into force and which were far too low by Memorandum standards, and the fact that the capacity of plant could be increased after approval of the chimney height, simply by giving notice of installation.

Mr. Beaumont had referred to the legal remedy for such cases which could only be applied when statutory nuisances occurred. Mr. Eade said it was often difficult to prove conditions prejudicial to health and sometimes difficult to prove nuisance. Nevertheless, the nuisance sections were the only method of attack and should be tried out where possible. Recently, when considering a case in his district, a point had arisen on which he would like Mr. Beaumont's views.

In Harlow, industry was situated away from the residential areas. The persons affected by smoke or fumes were those employed in the factories, offices and laboratories. Section 92 of the Public Health Act 1936 and Section 16 of the Clean Air Act 1956 both referred to "the inhabitants of the neighbourhood". Was the meaning of the word "inhabitants" broad enough to include these people who resided and inhabited houses elsewhere?

His Council's legal department had thought it an arguable point which might go either way and, in the case under consideration, it had not been necessary to proceed.

There seemed to be no case law on the subject and Mr. Eade would be pleased to know whether Mr. Beaumont had any experience in the matter.

Councillor E. Gibbons (Brierley Hill) instanced the difficulties and delays that were taking place over chimney heights between the Public Health Authorities on the one hand, and the Planning Department on the other, especially where planning was the prerogative of a different authority, and suggested that every effort should be made between the various officers of a Local Authority in agreeing on this matter amongst themselves.

S. Catchpole (Central Electricity Generating Board) was interested to hear Mr. Beaumont emphasizing the effectiveness of tall chimneys in controlling concentrations of sulphur dioxide at ground level, and Mr. Nonhebel's remarks on this subject.

He wished to mention the practical steps undertaken by the Central Electricity Generating Board in this field, in connection with their large new power plants.

Experience gained over the years in the Industry, coupled with the considerable research effort devoted to methods of pollution control, had led to the emergence of a clean air policy based on the elimination of smoke, the installation of high performance dust arresting plant and the use of the minimum number of very tall chimneys to disperse the gases high in the atmosphere. In the case of new plants, the term—minimum number—meant a single chimney.

At the modern coal-fired power stations now being constructed, the Generating Board spent some £3½ million on clean air measures which included plant for extracting the dust and a tall chimney.

In fact, dust extraction plant at those modern stations was designed to remove 99.3 per cent of all solids from flue gas. Tall chimneys—up to 850 ft. high—discharged the gas at a speed of 75 ft. per sec. (50 m.p.h.) and a temperature of 100°C. This high efflux velocity coupled with the considerable buoyancy of the gases had the effect of more than doubling the effective height of the chimney.

In the Presidential Address the conference had been given figures showing how emissions of sulphur dioxide had risen in London and in the rest of the country. For a nation which derived the greater part of its energy requirements from sulphur-bearing fuels, those increases reflected the growing energy needs of the economy.

However, emissions of sulphur dioxide were only part of the story. What was far more important, and informed opinion was agreed on that point, was the concentration of sulphur dioxide in the air we breathed. He emphasized this because there appeared to be a good deal of misconception about the distinction between emissions of sulphur dioxide and concentrations in the atmosphere. As Sir Alan Wilson pointed out, in spite of the increases in emission of sulphur dioxide there had been no corresponding general increases in sulphur dioxide concentration at ground level. Undoubtedly this had been due largely to the effectiveness of tall chimneys.

J. Green (Reading) stated that it was his view that a local authority could not insist on a guaranteed chimney temperature, or insist on the cladding of a steel chimney so as to prevent undue cooling of gases, although the latter might be dealt with as a condition of prior approval under Section 3. One of the problems arising from oil firing, was that of smuts, and he thought that the improper insulation of metal stacks was a big contributing factor to this problem. In Reading, a Code of Practice was supplied to Architects and Consulting Engineers proposing to install new plant, which included recommendations relating to:—

> the cladding and insulation of metal stacks; the construction of separate flues in chimneys; new installations conforming to a specified standard of performance for suspended flue gas solids; the application of efficiency tests to plant before it was "handed over"; the regular maintenance of the plant.

Mr. Green did not agree with Mr. Beaumont's contention that a local authority had no jurisdiction in cases of nuisance or conditions prejudicial to health arising from processes coming within the provisions of the Alkali Acts.

R. Buttery (County of Buckingham) asked whether with regard to chimney heights of 300 ft. and over, it was possible that the raising in the height of a chimney could result in an increase of dust fall-out and agglomeration in the area.

D. Jenney (Dorman Long (Steel) Ltd.) asked whether Mr. Hodgson could confirm that the tabulation in Fig. 17 was based on £ sterling and also whether the maintenance figures included direct operating labour charges.

It was agreed that the selection of plant was best left to experts but the buyer had to make the final decision.

Throughout those papers the dust and sulphur emission were shown in micrograms per cubic metre and it was requested that a standard should be considered as different people and organizations were quoted in different terms. There were grains per cubic foot, micrograms per cubic metre, parts per 100 million and also were those at N.T.P. or S.T.P. (i.e. 0° and 760 millimetres or 60°F and 30″ Hg.).

Dr. H. S. Bury (Bedfordshire County Council) asked if it was safe to assume that if we got our chimneys high enough, sulphur dioxide would be disposed of in the upper atmosphere under all conditions without danger.

In the brick industry, some quite tall chimneys had been built but still under certain conditions the gases descended to ground level quite quickly and in sufficient concentration to be easily detectable with the human nose.

Much more work was necessary to find out just how tall chimneys had to be, to be effective.

F. F. Ross (Central Electricity Generating Board) said the answer to Mr. Draper's question was simple and satisfactory. Within each of the new chimney structures there was a separate flue for each unit, and the units would normally be operated at full load or shut down.

In view of the repeated complaints at gatherings such as this that the Ministries of Health and Education claimed exemption, he thought it might interest members that in large cities in the U.S.A. it had been decided that Federal buildings would set a good example by burning fuels of low sulphur content.

W. N. David (Hoddesdon, Herts) stated that the Conference was gratified to hear from Mr. Morris of the Ministry of Power and the representative of the Ministry of Transport, of the unqualified support of the Society's clean air policy. He regretted that the same support was not forthcoming from the Department of Education and Science in regard to the matter of chimney heights. That Ministry were not prepared to co-operate with local authorities in implementing the Memorandum on chimney Heights issued by the Ministry of Housing and Local Government. He felt that this Government Department should not claim exemption under Crown privilege, but, like all public authorities, should do its best to conform with the best expert technical advice available with the recognized standards of good practice.

It placed local authorities in an invidious position when industrialists and others were compelled to construct high chimneys in accordance with the Ministry memorandum, whilst architects, with the Ministry of Education and Science Department support, refused to do likewise in respect of schools and other educational buildings.

Unresolved Problems in Air Pollution

(I) ALKALI &c. WORKS

by

F. E. Ireland, B.Sc., F.R.I.C., M.I.Chem.E. M.Inst.F.*

ABSTRACT

The Alkali Act recognizes that complete elimination of all industrial waste gases is impossible, although with concentration of industry into larger units and the erection of tall buildings, it is becoming more than ever necessary to solve the industrial problems of prevention rather than to rely on dispersion. There follows a review of some of the unresolved problems relating to sulphuric acid, nitric acid ceramic, iron and steel, non-ferrous metals, metal recovery and lime works.

THE first Alkali Act came into being on July 28th, 1863, following the recommendations of a Royal Commission and it was important as a piece of farsighted legislation. Hitherto legal practice had been to prohibit emissions causing a nuisance. The Alkali Act of 1863 allowed that if at least 95 per cent of the offensive emission were arrested the remainder, after dilution, might pass to air, thus accepting for the first time that complete elimination was not always practicable. The 1906 Act, which consolidated earlier Acts and is still the operative legislation, also recognized that prevention was not always practicable and required that noxious and offensive gases where discharged must be rendered harmless and inoffensive. It might be claimed that any discharge of noxious and offensive gas represented an unresolved problem of air pollution and if money were no object this might be so, for there are very few emissions, if any, for which a technical answer is not known. However, economics plays an important role in the interpretation of the word "practicable" and we have to recognize that whilst few plants for the treatment of waste gases before discharge can be one hundred per cent efficient and there must be some slip to air past arrestment plants, there are also processes where no economically practicable method of treating the gases has yet been devised. In both cases recourse must be had to suitably tall chimneys so as to reduce the resultant ground level concentration of the offensive constituents to below the threshold which constitutes a nuisance or a health hazard. The fundamental premise is that there are no such things as toxic gases, only harmful concentrations. The mechanism of dispersion from tall chimneys has been the subject of much scientific study in recent years and whilst there are still imperfections in the formulae which have been developed, it is now possible to calculate with sufficient accuracy the heights of chimneys to give acceptable ground level conditions. In this modern age even this is not always sufficient, for the erection of tall blocks of flats and office buildings has lifted the ground-level problems to a considerable height and it is becoming more than ever necessary to solve the industrial problems of prevention rather than to rely on dispersion. Where no means of prevention can be found it might be that the only practicable solutions are either to transfer the works to more suitable, industrial localities or to provide air conditioning for tall buildings in these special circumstances of air pollution.

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* Chief Alkali &c. Works Inspector.

The following is a review of unresolved problems of air pollution at works registered under the Alkali Act and in all cases the best practicable means are employed to render the emissions to air harmless and inoffensive.

Sulphuric Acid Works

A serious and far from tractable problem associated with contact sulphuric acid plants is that of acid mist formation. The alkali inspectorate require that such escapes shall be "mist free", but this is not easy to achieve, the particle size and physical state of the mist being such that it will pass through the conventional absorption plants in which sulphuric acid is soluble. Contact plants based on anhydrite as a raw material produce acid mist, as also do the two tower process plants in this country and suitable fume arrestment equipment has to be fitted, such as electrical precipitators, ceramic filters or fibre filters constructed of "non-wettable" materials. The unresolved problem relates to contact acid plants using sulphur as raw material and these may or may not produce a mist. Not until a new plant has been put into operation will it be known whether there is a mist problem or not and the design has to allow for later interposition of a mist arrestment unit should it be found necessary in practice. The remedy is expensive. It is not known for certain how, why and where this ultra fine mist of submicron size particles is formed in the plant, although many theories have been put forward. With one recent exception, all attempts to prevent the formation of mist associated with particular plants, or to absorb it in the system, have failed and recourse has had to be had finally to expensive arrestment plant.

Nitric Acid Works

The simply expressed process of nitric acid manufacture is to burn ammonia in air to form nitrogen dioxide (NO_2) which is then absorbed in water to form nitric acid (HNO_3). Unfortunately at each absorption stage some of the nitrogen dioxide is changed to nitric oxide (NO) according to the over simplified total equation

$$3\ NO_2 + H_2O = 2\ HNO_3 + NO$$

This evolved nitric oxide must be re-oxidized by excess air to nitrogen dioxide, before it can be absorbed. As the absorption proceeds in a series of stages the concentration of nitric oxide steadily falls and with it the rate of re-oxidation to nitrogen dioxide. In order to take the main reaction to virtual completion with removal of all acid gases would require a series of absorption towers so great as to be impracticable and a slip to air is inevitable. There is always some escape of oxides of nitrogen to give the characteristic, brown-coloured emission associated with nitric acid manufacture. The present provisional requirements of the inspectorate to meet the best practicable means clause are that the acidity of the undiluted escape shall be below 2·3 grains per cubic foot as nitrogen dioxide and that the height of discharge shall be such as to reduce the maximum ground-level concentration of nitrogen dioxide for a 3-minute mean to below 0·16 part per million. The brown nitrogen dioxide waste gas can be reduced to the invisible nitric oxide in a single stage and to the inert gas, nitrogen, in two stages by mixing it with hydrocarbon gases or with towns gas and then burning the mixture. This technique is used where a cheap source of gas is available, but so far the treatment has been considered to be too expensive for general application in this country. Should special circumstances arise in the siting of a new nitric acid plant it may be necessary to require tail-gas reduction and the manufacturer will have to decide whether it is economical to carry on with his project or not.

Ceramic Works

During the firing of clay products the most common noxious and offensive constituents of the emission are sulphur dioxide, sulphur trioxide and fluorine compounds, but there are also problems associated with special classes of the clay industry. There is not an indigenous raw material we have examined, including coal, which does not contain some fluorine compounds and in most cases some or all of these compounds are liberated when the materials are fired to a high temperature. Samples of clay were collected from many sites throughout the country and were analysed for sulphur content. The average concentration of sulphur was 0·3 per cent and the range was from negligible amounts to nearly 3 per cent. During firing the sulphur passes to air normally as sulphur dioxide or sulphur trioxide but in some circumstances hydrogen sulphide can be formed. When coal, coke or fuel oil are used to heat the clay, sulphur oxides and other noxious or offensive gases are emitted by the burning of the particular fuel. So far it has not been found practicable to treat the offending constituents, because the quantity of waste gas is so large, its temperature often so high and the concentration of material to be removed so low as to render any of the usual treatment processes uneconomic. The fletton brick industry comprises a chain of large brickworks in the clay belt stretching S.W. from around Peterborough to Bletchley. The clay contains considerable carbonaceous matter which provides the bulk of the heat for firing the bricks, but some of the volatile matter is driven off in the pre-heating chambers and gives rise to the characteristic "burning rubber" smell of the emission. Even the tall chimneys cannot adequately disperse the emission under all weather conditions to prevent local complaint of the offensive odours. Oxides of sulphur and fluorine compounds are liberated by all heavy clay works, but in the fletton industry the concentration of operations in a small area is so great as to cause some local difficulty from fluorosis in the grazing of cattle. It is frequently suggested that the emissions be scrubbed with water. This would be a tremendous task. Alongside the largest works at Stewartby is a lake, the only large local source of water, containing an estimated ten million tons of water. If this were used to scrub the Stewartby Works emissions on the lines of the Battersea and Bankside power stations, the enormous quantities of waste gases would use the contents of the lake in five days. The waste waters from the scrubber would also present a difficult problem of disposal unless a method of water treatment could be found and this is likely to be costly. The problem is under continual review. It is generally thought that any method of treating the emissions would be inadequate which removed fluorine and sulphur compounds but did not eliminate the "burning rubber" odour.

In the traditional salt-glazing of earthenware, common salt (sodium chloride) is thrown onto the kiln fires during the last few hours of firing, usual practice being to make from three to six saltings per firing. The salt volatilizes and passes among the ware in the kiln, some of it reacting with the burnt clay to form an impervious skin of sodium silicate. The emission consists mainly of unreacted salt and hydrochloric acid, but there are also present products of combustion, potassium compounds and traces of magnesium and ammonium compounds. During 1960 and 1961 the Inspectorate carried out thousands of

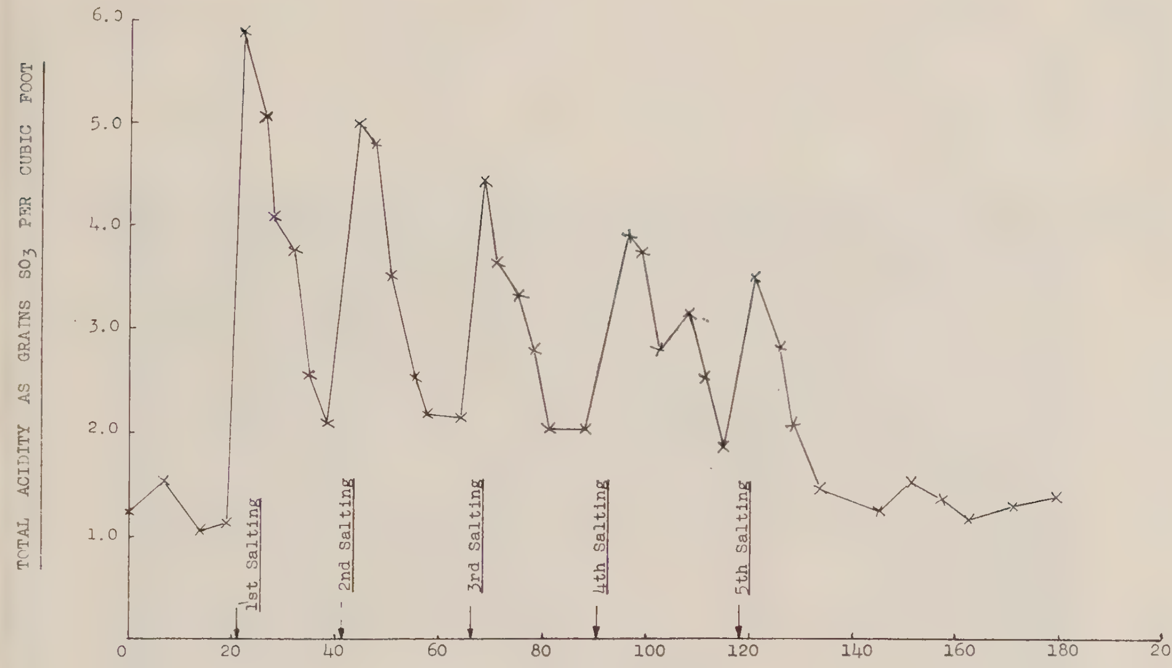

FIGURE I PLOT OF TOTAL ACIDITY DURING THE SALT-GLAZING OF EARTHENWARE

tests on the acidity of these emissions in order to establish the patterns at all registered works and to help determine the best practice. Immediately following each salt addition there was a rapid rise in hydrochloric acid emission followed by a gradual fall until the next addition of salt, when the pattern was repeated, but to a diminished extent. A typical acidity curve is plotted in Figure 1 and it will be seen that the acidities recorded are well above the 0·2 grain per cubic foot limit required by the Alkali Act for a Hydrochloric (Muriatic) Acid Works. The problem is one of eliminating hydrochloric acid and mist from very hot gases—the kiln temperature is of the order of 1000°C to 1200°C. A fairly simple water scrubber will remove hydrochloric acid efficiently but will still leave a mist problem, now further complicated by being saturated with moisture. To remove the mist would require an efficient and costly scrubber of the venturi type. A Working Party was set up to investigate the problem and as a result of its findings the Chief Inspector accepted that treatment of the emission which did not remove both hydrochloric acid and mist efficiently was useless but that the complete remedy was not economically practicable. The basic requirement now is that pending a solution to the acid and mist problems, all salt-glazing emissions shall be dispersed from chimneys not less than 120 feet high. This applies to all new kilns from the outset and existing works have a period of grace until the end of 1970 in which to install suitable chimneys or change to alternative methods of glazing.

Another unresolved problem of the ceramics industry is that of smoke emission from works using reducing atmospheres to give special properties to bricks. The most serious of these is the blue brick industry and Fig. 2 shows a typical emission during the reducing stage. The highest smoke density on the Ringelmann scale is five; but some critics would say that at times even this would seem to pale into insignificance compared with a blue brick works emission. Great attention has been paid to this industry since 1958 and a working party consisting of members of the industry, the trades research association and the alkali inspectorate has studied the problem. Blue bricks represent the highest grade of engineering brick and the blue colour is a guarantee of the desired properties, among them being density, crushing strength and resistance to acid attack, erosion and porosity.

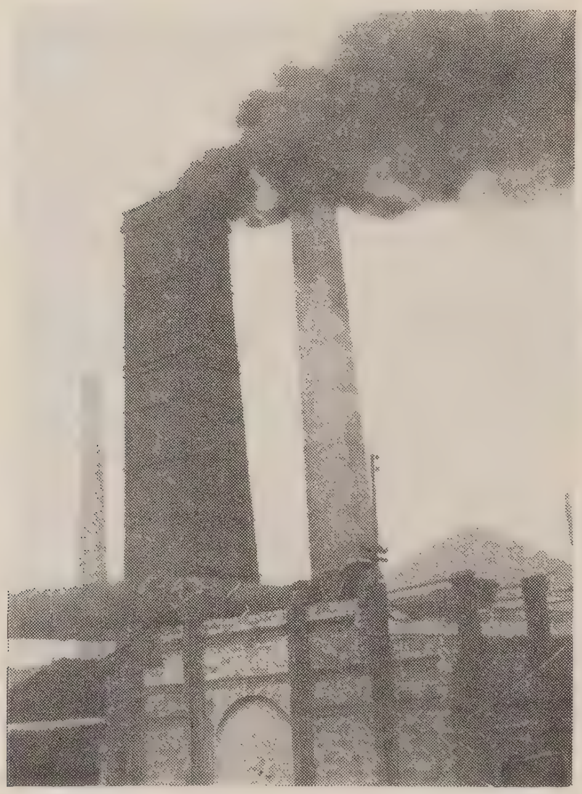

Fig. 2

Towards the end of the firing period fireholes are filled to the top with coal and secondary air holes are blocked thus allowing the ware in the kiln to become soaked in a sooty and reducing atmosphere. As the fires burn down an oxidizing atmosphere is restored. This cycle of reducing and oxidizing atmospheres is repeated several times and causes the ferric oxide to be converted to ferrous oxide which, in the course of firing, produces more—easily—fusible silicate complexes in the clays. At first efforts were directed towards the elimination of smoke at the source by modification of manufacturing methods and use of different fuels from the conventional coal. Limited success has been attained. It is claimed that by adopting a code of practice smoke from the whole firing cycle has been prevented by about 50 per cent, but the dense emission during reduction still remains where a high percentage of the best blues is the object. When a kiln is fired under reducing conditions the product is a mixture of blue, brown, brindled and even red bricks and the percentage of each quality depends mainly on the concentration of reduction. Some works have a ready market for brown and brindled engineering bricks and are content with a smaller proportion of blues. In these latter cases oil firing has been used successfully with only a small emission of smoke. Sadly, we came to the conclusion that for those works blueing intensively, dense smoke production was a necessity and the smoke emission had to be treated as a post-kiln problem. After-burning was tried in a variety of ways with tertiary air, an oil-fired afterburner and leading the waste gases into a kiln under full fire, but the complete practicable answer has not yet been found. However, a crack in the facade has appeared recently. The oil refinery technique of using steam to prevent refinery flares from burning inefficiently and causing smoke has been tried experimentally. Steam has been introduced into the hot gas stream entering the kiln and smoke has been reduced appreciably. There are not many ceramics works with steam to spare and when the technique has been mastered it is intended to try the more easily available water in the form of fine sprays. All we can say at the moment is that the results show promise, but the quality of the bricks must not be allowed to be lowered by the new technique and this has yet to be proved.

Iron and Steel Works

Perhaps the outstanding, unresolved emission problem of the iron and steel industry is that of the Bessemer converter. In this process, hot metal is refined by blowing air or oxygen, sometimes in admixture with steam or other gases, through the perforated base of the vessel. In order to prevent

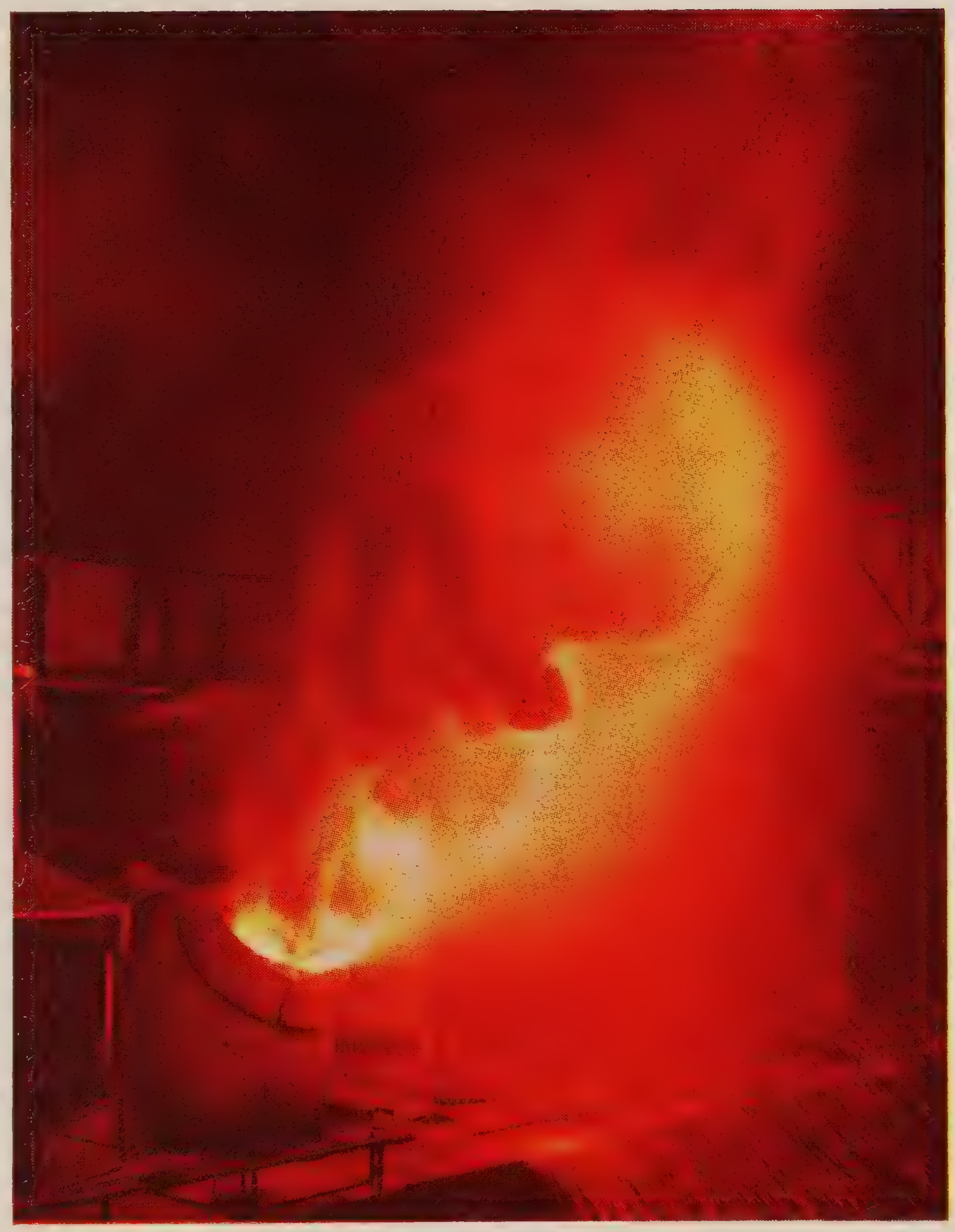

Fig. 3

(*By courtesy of Stewart and Lloyds, Ltd., Corby*) molten metal running into the blowholes and solidifying, blowing commences with the vessel in the horizontal position and then it is rotated into the vertical position. This happens frequently during a batch cycle and the problem resolves itself into one of containment. The temperature of the gases leaving the mouth of the converter can be as high as 2000°C and at times flames up to 40 feet long are ejected. See Fig. 3. The waste gases carry with them a dense, brown fume of sub-micron sized particles, mainly iron oxide, which only high-energy fume cleaning plant such as electrical precipitators, bagplants and venturi scrubbers can arrest. On the continent, where the problem is much greater than in this country, the European Coal and Steel Community set up an international study group which had an electrical precipitator fitted to a bottom blown converter for use when the vessel was in the vertical position. To have a chance of being economically practicable, steam had to be raised by the waste gases to offset the enormous cost of the venture. The intermittent nature of the process complicated the ancillary plant, but finally success has been claimed, although the emission to air during "turn-up" and "turn-down" remains. In this country industry and the inspectorate have recognized that it is only a matter of time before more modern refining techniques using converters top blown with oxygen will replace the traditional methods. The users of Bessemer converters have been given until the end of 1966 in order to make up their minds whether to continue using these plants or to adopt some other method of steel production. There are only three works in England and Wales using Bessemers and one of these is about to close down its Bessemer shop; indeed this might have happened by the time this paper is read at the Conference. It is hoped that the decisions in the remaining two cases will be to use alternative methods of making steel. Should any works elect to continue to use Bessemer converters they will be faced with the choice of installing really expensive fume arrestment plant or of dispersing the emission from exceptionally tall chimneys.

Another problem of the iron and steel industry is that relating to emissions from hot blast cupolas. The arrestment of grit and dust proved an easy matter with conventional plant and there have been no complaints on this score. The problem of fume treatment remains. There was no experience in this country of the application of fume arrestment in this field and early attempts with "guinea pigs" were disappointing or abortive. A working party consisting of members of the inspectorate and of industry was set up to study the matter. It considered that it was premature generally to require fume arrestment because of this lack of experience, but recommended that the industry should consider what steps it should take to solve the technical and economic problems. A few companies have installed or are installing measures such as electrical precipitators, bagplants or high-energy water scrubbers and their performances will be carefully examined. Meantime provisional best practical means is, briefly, to dedust the emission, burn the whole of the effluent gas and disperse the waste products from a sufficiently tall chimney.

Electric arc furnaces range from 1 to over 100 tons capacity and where oxygen is used for refining, arrestment plant has to be fitted to deal with the resultant fine fume. For small furnaces, say up to 10 tons capacity, closely fitting hoods collect the fume and lead it to high efficiency cleaning plant, with excellent results. This indirect method of collection allows the entrainment of a large proportion of diluting air and if used on the larger-sized plants would require the installation of uneconomically big arrestment units. Medium-size units tend to use a semi-direct collection method and the largest sizes go in for direct extraction from the furnace. As the furnace gases during oxygen blowing contain carbon monoxide, special precautions had to be taken to deal with the explosion hazard where direct extraction was employed and it can be claimed that these have been successful. Gases are burnt under carefully controlled conditions. Unfortunately another explosion problem has arisen during the "melting down" and "clear melt" stages and small bangs and explosions within the furnace have occurred. It seems that high concentrations of hydrogen and carbon monoxide are released suddenly and this problem is still receiving an intensive study.

Non-ferrous metals

In the wrought copper alloy industry, the emission problems are in the main related to dark smoke and zinc oxide fume. Where zinc is removed deliberately from the molten metal by blowing with air, bagplants are the common form of arrestment plant to be used and the fitting of such plant is obligatory. At many works melting copper alloys to specification, some zinc oxide is emitted to air adventitiously, together with carbonaceous matter from the use of contaminated scrap. Arrestment units, chiefly bagplants, were fitted at several works and preparations for others were made, but unfortunately some of the bagplants were burnt out and a fire was even experienced with a wet washer. It was thought that the fires were probably caused by the carry-over of large sparks and inertial arrestors were placed in the gas streams when the bagplants were rebuilt. A few have operated for about two years without incident but others have continued to have fires. There is evidence that the collected material is pyrophoric and if this is true there would always be a risk attached to dry collection methods. Provisional best practicable means have now been agreed as pretreatment of swarf, where necessary, to remove oil and thus prevent dark smoke emissions, and the efficient collection of adventitious zinc oxide and its dispersion from a suitably high chimney according to a formula worked out by the inspectorate.

During the secondary smelting of aluminium, i.e. recovery of metal from scrap, swarf and residues, there is considerable evolution of dark smoke and salt fume. The dark smoke has its origin in the use of contaminated scrap and the salt fume from the use of salt as a flux. The solution to the dark smoke problem has been found in the pre-treatment of oily swarf in furnaces fitted with afterburners, but there is as yet no breakthrough in the difficult matter of salt fume. In all good faith some plants were fitted with electrical precipitators and high efficiency wet washers, but none has managed to survive the highly corrosive conditions. In one case a stainless steel unit was installed but it only lasted a few weeks. These were expensive ventures for both the equipment makers and the aluminium smelters. The industry and the equipment makers are collaborating in a joint exercise to try and find a solution and meantime we have had to fall back on dispersion from tall chimneys as provisional best practicable means for salt fume.

Metal Recovery Works

These works were scheduled under the Alkali Act by the 1963 Order and the process consists essentially of removing the insulation from scrap cable by burning to recover the copper. Prior to scheduling it was common practice to burn the scrap cable in heaps on open ground and in yards, much to the annoyance of neighbours because of pungent odours and smoke from incomplete combustion. The older scrap cable is insulated mainly with rubber, but in recent years there has been an increasing proportion of cable insulated with plastics, usually polyvinylchloride (PVC), which are more difficult to burn smokelessly than rubber. As its name implies, PVC contains combined chlorine and on burning, the chlorine is liberated in various forms. Some of it combines with the metal to form metal chlorides, some is converted to hydrochloric acid gas and some can appear as carbonyl chloride (phosgene) under certain conditions of operation. Experiments are still being conducted in collaboration with the British Non-ferrous Metals Research Association to try and obtain representative analyses. So far, and until the studies of the compositon of the emission are completed, provisional best practicable means is efficient combustion to eliminate smoke with a well designed furnace and afterburner, and dispersion of the hot products of combustion from suitably tall chimneys. In some cases there are special problems of siting where dispersion is not thought to be acceptable and works have been pressed to fit simple water scrubbers. The performances of these scrubbers will be evaluated carefully. The requirements of the inspectorate have resulted in rationalization of the industry into fewer and larger units.

Lime Works

Lime is the cheapest of chemicals and it follows that it cannot stand the large oncost of expensive equipment. The problem of the industry is heavy smoke emission from the burning of lime through the agency of coal. Carbon dioxide is formed during the burning of carbonaceous fuel, but this is augmented in the case of lime burning by carbon dioxide liberated from the limestone (calcium carbonate). The problem resolves itself into that of burning coal smokelessly in an atmosphere heavily laden with carbon dioxide. Little progress was made following scheduling of Lime Works in 1958 but a crack has appeared in the apparently impregnable facade and it is widening.

New kilns erected during the past two years have been specially designed to burn oil by means of a two-stage gasification process and these have been successful in operating with little or no smoke and producing a quality of lime which meets the highest specifications now demanded by the iron and steel and chemical industries. There have been serious teething troubles in some cases. New kilns are costly items and it is going to take the industry many years to replace its established kilns. So far the conversion of existing coal fired kilns to oil-firing has met with many difficulties and it is not possible to recommend conversion with confidence at this stage of our knowledge.

The foregoing are considered to be the main, but not the only, unresolved problems of the Alkali Inspectorate. Some are a matter of degree of treatment only, others relate to dispersion without treatment. In such industries as the sintering of iron ores and smelting works, the effluent gases are efficiently dedusted, but no attempt is made to deal with the sulphur dioxide content apart from dispersion. No practicable method for removing small concentrations of sulphur dioxide from hot waste gases has yet been developed. The search for solutions and improvements to industrial emissions continues unabated, both nationally and internationally. As other countries introduce clean air legislation, the interest widens and every opportunity is taken of exchanging information with other air pollution control departments abroad. We can be proud of our own record.

(2) THE LOCAL GOVERNMENT SPHERE

A Report of the Parliamentary and Local Government Committee, Presented by E. M. Birtwisle

ABSTRACT

1. **The allocation of certain processes to control by Alkali Inspectors removes many of the unresolved problems from the local authority field.**
2. **Domestic smoke control work is still affected by changes in the types of solid smokeless fuel available.**
3. **Whilst smoke from industrial plants is not now so serious a problem grit and dust and burning of materials in the open air still require more effective control.**
4. **Pollution by sulphur and road vehicle exhaust continues.**

Introduction

THE Clean Air Act of 1956 came to us in a hurry. Generations of agitation for some effective system of control of atmospheric pollution and unremitting pressure by many influential bodies seemed to have little effect on our legislators. It was the effect of statistics relating to a week of serious fog in December, 1952, which stirred the public conscience to a degree which showed their readiness to accept control. Once the government had accepted the need for action matters moved swiftly. Sir Hugh Beaver and his committee took only sixteen months to produce their recommendations and legislation was in operation in just over two years from the presentation of the report.

It is a remarkable testimony to the effectiveness of their recommendations, and the Act which incorporated them, that unresolved problems are comparatively few. Work in the local authority field is the more straightforward because generally in the case of industrial processes in which the prevention of dark smoke, grit, or harmful gases presents special technical difficulties, responsibility for ensuring the use of the best practicable means for prevention is vested in H.M. Alkali Inspectorate.

The allocation of certain industries to the control of the Alkali Inspector does not mean that all local authority problems are simple and easy to deal with. Public Health Inspectors are faced with many specialized forms of pollution which require detailed study to decide on the best remedial measures, but even where methods of abatement are generally known there is still considerable resistance by manufacturers to improving their methods of operation so as to eliminate pollution. There should not be any relaxation of pressures whilst waiting for additional legislation or for trade processes to change. Any practicable means for minimizing pollution should be required even though they might not represent the ultimate in effectiveness. Given the full and energetic operation of the Act in all areas these British Isles could, by 1970, have a very different appearance from that of 1956.

The possibility of new legislation is brought nearer by Mr. Bob Edwards, M.P. being given permission to introduce a Bill to amend existing legislation to give local authorities more powers to control air pollution. The committee will be considering suggestions for new powers and would be glad to have the views of members and delegates.

Domestic

Work in smoke control areas is still affected by the continuing alterations in the supply of solid smokeless fuels. Adequacy of fuel has never been in doubt but the need to arrange for the burning of harder cokes has in many areas called for changes in types of appliances and adaptations required and raised considerably the general level of grant payments. It now appears that the White Paper of December, 1963, was unduly pessimistic about the ability of the premium fuel producers to step up production and that the swing to harder cokes might now have reached its limit and be turning back towards the use of more reactive cokes. If this change materializes a further amendment of policy on grate conversions will be needed, bringing us back to the fitting of the simpler and less expensive appliances.

These developments in solid fuel supply indicate that we cannot expect to have a rigid formula which will govern our future smoke control work and that a much greater degree of flexibility will have to be accepted. Increased supplies of premium fuels, insofar as they provide an even greater freedom of choice and may well eliminate the need for firegrate conversions, should help to make smoke control work more acceptable to householders.

There is a lot of interest in the smoke control area idea and suggestions of reluctance on the part of householders to accept control have to be modified in the light of pressing requests in some areas that programmes should be accelerated. The making of smoke control orders also has the effect of producing amongst residents a new consciousness of air pollution. This often gives rise to demands for the elimination of forms of pollution which previously would have passed without comment. Garden bonfires and the burning of rubbish on waste land and industrial sites are more and more being regarded as matters requiring stricter control. Any smoke emission from commercial or industrial chimneys arouses immediate comment.

Industrial

Local authorities generally feel that there is a wide range of industrial problems which are unresolved and would expect the highlighting of these in this paper. As mentioned above official policy has placed responsibility for problems involving special technical difficulties with the Alkali Inspectorate of the Ministry of Housing and Local Government. The Chief Inspector will be reviewing unresolved problems in their field in a separate paper and no detail is discussed here. It is appropriate to comment that problems range over almost the whole of industry and many are on the borderline with local authority control. Close and continuous co-operation between the Alkali Inspectors and Public Health Inspectors is called for. Rarely have central and local government officers co-operated as effectively as in this field.

Smoke discharged from chimneys of boiler plant, which formerly was a major polluter, does not now seem to be a problem except perhaps where industrialists with a private balance of payments problem are trying to continue with out-of-date plant. The seven years' grace which provided a special defence in such cases expired in 1963. It should be no hardship to insist on strict compliance with smoke emission limits. More difficult is the plant which emits grit and dust from the chimney, but a discussion on the choice of equipment for collecting grit and dust will follow a paper by Mr. John Hodgson presented earlier in the conference. The Ministry of Housing and Local Government have a working party considering the standards and methods of measurement of grit and dust emission from furnaces. It is hoped that Regulations will quickly follow their report and enable the more accurate identification of plant giving rise to emissions and the application of effective control measures.

Cold blast cupolas have long been regarded as an outstanding example of grit emitters. Where pressure has been firmly applied satisfactory progress has been made to solving the problem of emission from these furnaces. Some hesitation seems to exist as to the effectiveness of wet type grit arresters but it is important that pressure should be continued on manufacturers to use the means currently available to minimise pollution. Further progress in the acceptance of suitable methods should follow the work at present being done by a working party of the Standing Conference on the Investigation of Atmospheric Pollution. It is hoped that the report on their investigations will not be long delayed and that its recommendations will be quickly implemented.

The height of chimneys is obviously a most important factor in eliminating nuisance from sulphur and other chemicals in gas form and also the finer grit particles. The Clean Air Act purports to give local authorities control over chimney heights. The shortcomings of this provision will no doubt be dealt with in full by Mr. S. C. Beaumont in his paper presented earlier in the conference, but the limiting of control to submissions under building byelaws allows many new buildings not controlled by byelaws to have ineffective chimneys, and the lack of control of existing chimneys or to deal with chimneys fitted with new plant leaves serious loopholes.

Many causes of pollution do not arise from chimney emissions. Smoke from the burning of materials in the open produces problems in many areas. Certain materials such as those found in old motor vehicles and railway carriages, which are burnt in order to recover the metal, give rise to very pungent smoke. Section 16 of the Clean Air Act requires proof that the neighbourhood where such pollution takes place is inhabited before action can be taken and much pollution on derelict or industrial sites continues because of this limitation. Some "local Act powers" are designed to deal more specifically with these cases; these powers should be available throughout the country, and any amendment of the Clean Air Act provide for these or better powers to control this nuisance.

Some authorities seem to be encouraging the burning of refuse to avoid straining the refuse collection arrangements. Burning refuse in small incinerators is a risky business; satisfactory incineration is not easily attained; unsatisfactory incineration is a serious problem and with the new interest in smoke control generated by smoke control area work crude burning of rubbish, including garden refuse, should be actively discouraged. Efforts should be made to deal with all such rubbish other than by burning. The increasing call on refuse collection services is part of the price we must pay for cleaner air.

Even where there is no combustion quite serious air pollution can arise. The national press highlights many cases where action is called for to deal with dust from a variety of processes: brick crushing, stone crushing, ash removal from power stations and collieries, coke handling at gas works, dust from cement works, wood dust from sanding operations and slag dust from tarmac and asphalt plants. A great deal of the handling which gives rise to such dust emissions takes place in the open air. In other cases it is necessary for the material to be kept as dry as possible; the use of water sprays does not seem to assist in solving the problem and filtration or precipitation is difficult to apply. Powers to deal with such cases (where they are not associated with scheduled processes of the Alkali etc. Works Regulations Act) are in the nuisance sections of the Public Health Act, 1936, but as formal action under these provisions requires the specification in the abatement notice of works which are required to be done to abate the nuisance, few cases seem to get past the stage of informal pressure.

Sulphur and Road Vehicles

Probably the major unresolved problems in the local authority sphere of air pollution are sulphur and petrol and diesel exhausts. Sulphur we know to be a highly undesirable contaminator; road vehicle exhaust may well be harmful and at the best is most unpleasant.

The sulphur problem has been considered by our colleagues, the Technical Committee, and a special report to conference last year discussed the issues in detail. It remains a matter of concern that little can at present be done to eliminate this form of pollution and that the possibilities of some form of removal being adopted in the future is only considered practicable for industrial installations. We are conscious that a great deal of the sulphur emitted comes from domestic fireplaces and short of the removal of sulphur in the manufacture of solid smokeless fuels there would seem to be no answer to this part of the problem.

The dispersal of sulphur at acceptable heights by controlling the height of chimneys is currently the main safeguard, but with so little control of many chimneys and the possibility of calculations of height being upset by changes in the fuel or plant used with the chimney, the effectiveness of this method is to be doubted.

Road vehicles are usually seen to be causing serious pollution when their engines are not being used at the efficiency for which they were designed. Smoke issuing from an exhaust pipe indicates a badly maintained or ill-used engine and this should be prohibited; more difficult to control is the cumulative effect of large numbers of vehicles in congested town streets or even on crowded country roads. The widespread use of smokeless forms of traction may be a reality in the future, but with the very rapid increase in motor vehicles fitted with traditional power units how are we to deal with the current problem?

Discussion

W. Combey (Oxford) referred to his remarks during the session on "Odour Control by Catalytic Combustion" and said that considerable trouble had been experienced from paint odours from paint stoving processes in the Cowley industries. There seemed to be need for attention to this form of air pollution because of the large volumes of paint used by some industrial concerns, much of which found its way to waste. Problems could be created by disposal of waste paint, including pollution of the atmosphere. Tests for solvents in the air locally had proved that only threshold amounts were detectable but odour nuisance appeared to be created by the breakdown of basic pigments in certain paints. This was giving rise to considerable concern and special investigation. Catalytic combustion was not always the answer and there was need for exchange of information and experience in regard to this and other forms of air pollution. Mr. Combey then said that if he could descend from the comparatively sublime to the probably ridiculous, could anyone suggest a method of dealing with odour problems from hot dog stalls and vehicles? This was a never-ending source of complaint. He would be glad of helpful information if there was any available!

J. H. Burrows (Eston) said that arising from the Tuesday afternoon's Conference papers "Success with Smoke Control" and Wednesday morning's paper on "Research Findings in connection with Mortality Rates in Lung Cancer and Bronchitis" two important facts had emerged which were both closely connected with Friday morning's paper by Mr. F. E. Ireland.

The facts were that work towards improvements in atmospheric pollution from industrial and domestic sources had to go forward at one and the same time, and that bronchitic conditions in workers and others would appear to bear some connection with industrial pollution especially within the iron and steel industry.

Eston was an iron and steel producing area with heavy pollution occurring from the processes of ore sintering, oxygen lancing and coke oven practice.

Some two years ago at the Conference of this Society held at Scarborough Mr. Burrows spoke to the paper "Administrative Problems of Control" and drew attention to the point that while industrial pollution, over a ten-year period up to 1961, had shown a marked reduction in general, throughout Tees-Side, Eston had shown increase in its deposit gauge readings.

Today Eston was still monitoring with deposit gauge apparatus and showing heavy readings within the industrial belt of North Eston and the insoluble deposits recorded, indicated by analysis that almost 50 per cent of this deposit in each of the gauges was ferric oxide. It would appear therefore, from this evidence, that even though certain improvement had been effected, emissions from the iron and steel firms in this district were still very heavy. Means of suppression had to be effected at an early date if clean air was to be attained in the district.

Within Mr. Ireland's paper mention was made of improvements in the iron and steel industry together with unresolved problems, but no mention was made of coke oven practice. There was here an industry which emitted sulphur compounds, volatiles, grit particles and water vapour all at low level and he contended that very little improvement from the clean air point of view had been effected in this industry since the immediate post-war era, some twenty years ago. Would the Author comment on the possibilities of improvement in this field?

In conclusion Mr. Burrows respectfully suggested that the iron and steel industry required to take a more serious view of dust, grit and fume suppression than was evident at present. It was most important that in the interests of public health, suppression of both domestic and industrial air pollutants had to be dealt with at one and the same time. Enthusiastic public opinion could not be obtained in the domestic programmes of smoke control when measures to suppress pollution in the industrial field were so slow.

Councillor J. Sanders (Warwickshire Clean Air Council) recalled to the Conference that twelve months and two years ago, he had moved resolutions calling on the Government to implement a National Fuel Policy. It would appear that the call had not gone unheard and the White Paper on a Fuel Policy was presented to Parliament by the Minister of Power in October this year (1965).

While recognizing that this went some way towards achieving their object, he still felt it necessary to press the matter further and Conference had expressed that view repeatedly that week.

Therefore, he called on Conference to support this further resolution, which he moved in the name of the Warwickshire Clean Air Council:—

"That our best scientific knowledge should be employed to advise regardless of existing fuel interests on the most effective and economic form of home heating compatible with the attainment of clean air and to recommend a continuing revision of the National Fuel Policy in the light of such advice."

P. H. G. Grimmett (Wednesfield) commented that there had been much mention of economics during the course of the Conference and referred to Mr. Ireland's comment on the first page of his paper: "Economics plays an important role in the interpretation of the word 'practicable'." Mention had also been made of the amount of pollution that the public could tolerate.

Mr. Grimmett questioned the interpretation of economics and whether it was in respect to the amount of dividends that were paid to the shareholders or to the fact of the number of respiratory deaths that occurred in relation to atmospheric pollution. We were advised by a speaker last year that the relating deaths were 44,000 per year in the 45/55 age group of people, who normally should have a longer life and who in the prime of their years were cut off, instead of giving ten to twenty years more useful life to the community and thus producing a more economical return.

Reminding Conference that payments of deaths grants to 44,000 people totalled £880,000 which monies could be invested and utilized in a much more productive manner, Mr. Grimmett again raised the point that a grant should be made from the National Health Service to provide for help where problems were financially difficult to face, and that the factories and firms concerned should receive Government help to overcome the aspect of gross pollution.

It was logical that the cost of equipment had to run its economic life but if in fact that equipment was detrimental and costly in other ways to the public and nation it should be replaced without regard to its economic life. Mr. Grimmett pointed out that 1d. per head of the population (55 million) would produce £230,000, thus national help to difficult problems did not have to be a heavy burden, taking into account the sickness costs being saved.

Regarding Mr. Ireland's reference to tall chimneys, Mr. Grimmett wondered whether such chimneys, these "edifices to inefficiency" could really be said to be the right approach, and whether it was really the answer to put up even higher chimneys so that pollution was transferred beyond the local boundary to other people's neighbourhood.

With reference to the report by the Parliamentary and Local Government Committee, Mr. Grimmett thought no grants should be given outside smoke control areas. He also said that if in fact bonfire smoke was a disseminator of carcinogens such a source if so confirmed should be eliminated. He asked whether the findings of Professor Pybus of Newcastle University should not be looked into; Professor Pybus had stated that there was a higher concentration of carcinogens in garden vegetation smoke than there was in normal fuel combustion smoke. If this was right then there was information which could be utilized, and the Medical Research Council ought to give some views on the matter.

R. S. Relf (Cuckfield R.D.C.) referring to the opening remarks of the second paper that "The Clean Air Act, 1956, came to us in a hurry", said it was not surprising that there were still unresolved problems.

Residences, shops and offices were specifically excluded from the (chimney height) provisions of Section 10, yet owing to the loose interpretations existing of "shop", certain premises which ought to come within control were not. He instanced launderettes which often had high capacity boilers to serve often relatively small premises—frequently in terrace shopping areas with living accommodation over. Being accepted as "shops" these were not covered by Section 10.

There was still doubt in the minds of many officers whether certain chimneys should or should not be subject to building byelaw control. Even when plans were submitted under the byelaws, non-notification of refusal within the four/five week period meant a deemed acceptance. In some of the smaller authorities there was often a delay in transmitting to the Public Health Department notification of the receipt of plans covering erection of a chimney which, to be dealt with adequately under Section 10, in nearly every case, required additional information which the architect in turn had to obtain from the heating consultant.

He thought this aspect ought to be tidied up with a clear indication that the erection of any chimney required submission of plans with the provision that adequate time should be allowed for the local authority to make a decision. He noted that whereas under Section 10 the Minister could accept an appeal from "any person interested", under the Building Byelaws only a "joint application" could be accepted.

The effect of Section 3 (4) was to bring domestic boiler installations over 55,000 Btus within control. Prior to 1956 domestic boilers of 20,000–40,000 Btus were a "standard" but today with partial or full central heating becoming so popular, boilers well in excess of the 55,000 Btu rating were so common that—with the doubtful advantage of "notification"—one wondered whether a complete relaxation of domestic notification or the amendment of rating to a more realistic figure of say 100,000 Btus was not called for.

The paper, in dealing with Section 16, stated that "Some authorities seem to be encouraging the burning of refuse to avoid straining the refuse collection arrangements. . . . Efforts should be made to deal with all such rubbish other than by burning. The increasing call on refuse collection services is part of the price we must pay for cleaner air."

Mr. Relf could not agree too strongly in this connection.

He concluded that unless a change in official thinking occurred, the descendants of the present inhabitants of this Sussex village might well have to go to places like Manchester or Sheffield to get a "whiff of clean, fresh air".

County Councillor J. T. Walker (York (North Riding) C.C.) said it was disgusting that people living between Redcar and Eston had to suffer because the modern methods of producing steel quicker were making more pollution, and stressed that much could be done to solve the problem of ferric oxide fumes from spreading over the Cleveland area.

Councillor Walker, who had worked in the steel industry for more than thirty-five years, said that the poisonous atmosphere was worse now than it had been from the steel plants forty years ago. It was not true to say that modern industry necessarily brought less pollution.

Redcar Council had, in the face of public opinion, to delay declaring a clean air zone in Redcar because of the pollution. They were determined to see that something was done urgently.

R. A. Margoschis (Atherstone R.D.C.) referred to the problem of pollution from road traffic.

For four years he had measured the traffic smoke in the main street of Atherstone. Over the first three years traffic flow had increased from 10,250 to 12,750 vehicles per day—and pollution increased accordingly. At the beginning of the fourth year traffic flow was substantially cut to 3,000 vehicles per day by the provision of a by-pass, and traffic smoke pollution was cut by one half.

He stressed that this was in a long narrow "canyon-like" street with poor ventilation. There was no evidence of this pollution spreading from the immediate vicinity of the traffic—a fact which had been supported by the findings of other workers. This led him to believe that the problem was not likely to be serious in wide open streets.

It appeared to him that the problem could be solved by the Ministry of Transport and the planners in the following ways:—

By instituting the proposed smoke measuring regulations for vehicles, referred to earlier in the Conference, at an early date.

By providing by-passes and ring roads wherever possible, and

By planning open, well-ventilated streets along with all forms of redevelopment.

There was no denying that the problem of pollution from vehicles was with us and would get worse unless something was done but we should get our problems in the right perspective and not allow the question of vehicle pollution to overshadow the main problem of domestic and industrial pollution, about which local authorities already had power to act.

C. Mann (Chailey R.D.C.) referred to the calcining of bricks in clamps. He said that there were a number of clamps in the Chailey Rural District Council. Each clamp was stacked with up to 750,000 bricks, the "wet" bricks comprising approximately 66 per cent clay 33 per cent screened town refuse and P.F.A. The whole clamp was then fired and burnt for up to six weeks. No chimney could be employed and this resulted in an offensive pall of fumes being given off at ground level during the whole period of firing.

Mr. Mann asked Mr. Ireland if there was any way of mitigating the nuisance.

Alderman Miss S. Terry (Redbridge) expressed her appreciation of the Conference and said that although she had attended many Clean Air Conferences she had only once before spoken. Despite the general opinion she thought women generally preferred to listen. She felt that because of the joining up of so many boroughs there were fewer women representatives, and it reminded her of the song "Where Have All the Flowers Gone". Nevertheless, she thanked the Chairman who had appealed to the women members present to come to the rostrum for the opportunity to ask a question.

At the beginning of the Conference it had been remarked that an area less than five miles square was of no use as a smokeless area, whereas it had been said at this, the last morning, that any area however small was of importance as a smokeless area, and she would be interested to have Mr. Birtwisle's comments thereon.

Dr. J. S. Hamilton (Stoke-on-Trent) took up two points in Mr. Ireland's paper. He suggested that a good heather brindle brick had crushing strength and other properties as good, if not better than, blue brick and that brindle bricks were often used as architectural features only and not necessarily for engineering purposes. It was time that we educated architects and asked for brindle brick rather than blue and so solved this serious problem in major part.

He pointed out that the Berryhill Brickworks had produced a very high proportion of good blue bricks by oil firing though the production cost was, at present, higher than by coal firing. He asked if Mr. Ireland would agree about the aspect of brindle brick and if he knew about the recent Berryhill experiments. He also asked whether any experiments had been made in the chemical extraction of fluorspar from heavy clay to give a fluoride free body in the same way as had been successfully done for china and earthenware body.

Dr. Hamilton then took up the point in the second paper about garden bonfires and the burning of rubbish on waste land and industrial sites. He believed that this should be very heartily condemned. The smoke from these smouldering heaps was usually dark, irritating and generally foul smelling, especially when the material was damp. Smoke from garden refuse contained carcinogen benzpyrene and samples had shown as much as seventy parts of benzpyrene per million of free carbon. The smoke from these fires was at ground level and penetrated surrounding houses very readily. It was particularly irritant and harmful to people who already had bronchitis, asthma or any form of chest trouble and could have serious effect on them.

Dr. Hamilton suggested that the Society should press very hard for legislation to prevent this nuisance. He stated that in his view Section 16 of the Clean Air Act and the nuisance sections of the Public Health Acts were quite useless for this purpose. He suggested that augmented legislation might be required to compel local authorities to provide a free removal service for garden and industrial refuse.

He finally suggested that his general impression of the Conference had been that they were perhaps losing their way a bit and becoming too complacent; that the drive and initiative and forward surge, present before the introduction of the Clean Air Act, seemed to be missing. He suggested that the next Conference should dedicate itself to the unsolved problems, including the failure of some authorities to do their duty and to consideration of the future, including the next steps in legislation. This sense of urgency and purpose had to be regained for there was yet a great deal to be done, both in consolidation and progress under the present Act as well as in forward thinking for the future before we indeed had clean air.

Councillor Mrs. I. Jones (Hyde) asked whether anything could be done to control smoking on enclosed premises such as were being used for the Conference.

F. M. Shaw (The British Cast Iron Research Association) wished to comment on the statement in the paper presented by Mr. Birtwisle "some hesitation seems to exist as to the effectiveness of the wet arrester . . ." If we were trying to cure a grit and dust deposition problem there was no doubt in his mind that a well-designed and maintained wet arrester provided an excellent answer. All the complaints of deposition from cupolas of which he knew had been successfully stopped by the fitting of wet arresters.

If, however, the problem was of smoke or metallurgical fume, then it could not be pretended that the wet arrester was of any use. This point was recognized in the Agreement between a number of West Midland authorities and the industry on the use of wet and dry arresters. This specifically stated:—

> "In a comparatively small number of instances, particularly where dirty scrap is melted, although there is a diminution of grit and dust brought about by the fitting of a wet arrester, there may still be an emission of smoke."

Disappointment was bound to be felt, both by local authorities and by foundry owners, if wet arresters were used in an attempt to solve problems for which they were not suited. Nevertheless, the wet arrester was coping excellently with probably the major difficulty caused by cold blast cupolas—that of grit deposition.

Generally speaking, smoke could only be removed by combustion, which was possible in many cases. Metallurgical fume was normally a minor problem with cold blast cupolas, but if it had to be dispersed or collected it was technically possible but usually prohibitively expensive.

Another point which was often raised in connection with wet arresters was the cooling of the effluent gases, and it was argued that this cooling was a bad thing as it reduced the natural thermal lift. It should be noted, however, that where combustion took place in the cupola stack the effluent gas temperature from a wet arrester was about 300°C, which was higher than the gas temperature from most boiler plants. If no combustion took place then the exit gas temperature was less than 100°C, regardless of whether a wet arrester was fitted or not. It might be heresy to suggest that cooling of gases made no difference to the trajectory of the gas plume but observations on a number of cupola plants indicated that the gas temperature had no marked effect on the path of the plume. This was probably because the heat flux from a cupola was fairly small. There was no doubt in the case of large heat fluxes, e.g. from power station chimneys, that gas temperature did affect the plume rise. This point was mentioned in the Beaver Report, p. 53:—

> "For small installations and for large ones emitting cool gases the thermal rise is unimportant . . ."

As Mr. Birtwisle mentioned, there was a Working Party consisting of representatives from local authorities, the Ministry of Technology, and the industry, considering the problem of cold blast cupola emissions, but, as yet, this Working Party had not reported.

S. F. Oldland (Drummond Dust and Fume Extractors Ltd.) first wished to congratulate Mr. Ireland on his most complete and concise summary of the outstanding problems of fume collection.

Some of the audience already knew some of this in a general way, but he had never previously seen it all collected together in this vivid manner. It should serve as a text book, not only for those who were concerned with enforcing fume prevention, but also for the manufacturers, who were trying all the time to improve their apparatus to meet these requirements.

Secondly, he wished to support Mr. Birtwisle's view that in order to minimize the nuisance of open burning of refuse, industrial, as well as domestic, local authority services had to be improved. At present domestic refuse was collected free, whereas industrial refuse was charged for, and while this might have been logical in the days of de-rating, now that industrialists were paying full rates on their assessments and were still not getting many of the other local authority services such as education, it would seem just that the collection of industrial refuse should be free, and if it was, most industrialists would be very glad to be rid of the unpleasant problem of burning their own refuse.

F. F. Ross (Central Electricity Generating Board) referred to Mr. Ireland's remark that there were no toxic gases, only harmful concentrations. Was this a profound statement or an excuse? One method of examining such a statement was to push it to absurdity and see if it still made sense. For example, oxygen could not be tolerated for long at 100 per cent. Carbon dioxide could be breathed in admixture with oxygen at 100 times its normal concentration in air. With nitrogen oxides there was a sharp distinction between a lethal dose and one of no apparent permanent harm. Sulphur dioxide had been found harmless to the health of those used to it at concentrations unbreathable by strangers. It seemed that both concentration and circumstances were more important than the nature of the gas, and even if one tried to make it seem ridiculous the statement could not be faulted.

L. Mair (Newcastle-upon-Tyne) stated that there were many unresolved problems associated with smoke control areas after they had been in operation. In his own authority he described one smoke control area where, almost at any time, smoke could be seen emitted from one or more chimneys of dwelling houses contrary to the requirements of the smoke control order. On investigation, the circumstances of the occupier were carefully considered, and whilst there had been a goodly number of successful prosecutions against householders, resulting in some cases in the maximum penalties being applied, it was found that in the majority of cases of unlawful smoke emissions the occupiers were old-age pensioners, persons in receipt of national assistance or householders otherwise in necessitous circumstances. Many of these people, particularly the pensioners, could not really appreciate the significance of smoke control and to them it was merely some new-fangled idea beyond their ken. Almost invariably these offenders had obtained their coal supplies from street vendors delivering in the area, and experience in Newcastle, stated Mr. Mair, had shown that the delivery of bituminous coal in smoke control areas was a major contributory factor in undermining the authority of a smoke control order. Mr. Mair reminded the Conference that reference to this problem of the sale of coal in smoke control areas had been mentioned at the opening session earlier in the week, but the point was not pursued. He expressed the view that there should be some form of control over the sale or delivery of coal to premises which were subject to an operative smoke control order, but whether this could be incorporated in legislation was a matter for investigation.

Mr. Mair continued by referring to the difficulties he had experienced in Newcastle because of the lack of 'power of entry' for the purpose of investigation Section 11 of the Clean Air Act. He reminded Conference that the power of entry was restricted to the purposes of Section 12 relating to works of conversion and he felt that it was imperative to enter premises for the purpose of establishing which fire was causing an unlawful smoke emission. He instanced obvious difficulties inherent in dealing with the house in multiple occupation where a single chimney pot, in a forest of chimney pots, was emitting smoke. The building contained several occupiers and it would be manifestly unjust (and a waste of time and money) to prosecute all the occupiers.

Authors' Replies

Mr. Ireland said he did not agree with the two speakers from the Tees-side area that domestic and industrial problems should only be tackled side by side. He believed that both sides should go ahead independently and as fast as they could, neither waiting for the other which might have run into technical difficulties. In the case of smoke pollution, ten years ago it was estimated that industry and the domestic fire were each responsible for 50 per cent of smoke emitted in this country. Both sides had made progress but industry had moved the faster and was now responsible for only an estimated 25 per cent compared with 75 per cent from the domestic fire. The iron and steel industry was vigorously tackling its problems in the North-east. It had already made considerable progress, but had run into temporary teething troubles with new arrestment plant. It was only a matter of time before their house would be in order. Mr. Ireland thought it would be wrong for industry to have to slow down its efforts to enable the local authorities to catch up with their domestic problems. Mr. Burrows had referred to pollution from coke ovens and while Mr. Ireland agreed that coke ovens could never operate without the neighbourhood being aware of their presence he did not regard them as being an unsolved problem. A working party consisting of members of the inspectorate, the industry and the research association had issued a code of good practice for the minimization of pollution from coke oven operations. The difficulty was in getting existing works to reach modern standards, although, contrary to local beliefs, he held that improvements had been made in recent years.

In reply to Mr. Grimmett, Mr. Ireland said he thought Mr. Grimmett might have misunderstood the position in regard to dispersion of pollutants and what concentrations the public should be asked to tolerate at ground level. Whenever Mr. Grimmett approved a chimney he was, albeit possibly unwittingly, asking the public to tolerate a certain maximum ground level concentration from that particular source and if he used the Memorandum on Chimney Heights as his guide he was obtaining a concentration for sulphur dioxide of 0.16 p.p.m. for a District C type of area for a three-minute mean. Dispersion was never regarded as a substitute for prevention and Mr. Ireland refuted the statement that chimneys were "edifices to inefficiency". No arrestment plants were perfect and where no practicable means for removing a pollutant was known, such as the removal of sulphur dioxide from the burning of fuel, it was inevitable that there should be some waste matter emitted to air. Chimneys were being used as a scientific tool to ensure adequate protection of the public and were not a policy of despair. Mr. Ireland thought the domestic fire was a far greater culprit than the industrial chimney.

Mr. Ireland told Mr. Mann that the calcining of bricks in clamps was not a process scheduled under the Alkali Act and personally he could see no solution to its emission problems in the foreseeable future, except to hope that this method of making bricks might be replaced by methods more amenable to control of emissions.

Mr. Ireland agreed with Dr. Hamilton that blue bricks were chosen by architects for many duties for which other types of engineering brick were adequate in terms of their physical properties. He said he knew all about the Berryhill trials and his officers were keeping him well informed of results here and elsewhere. He knew of no practicable method of removing fluorine compounds from the raw materials used in brickmaking.

In a brief reply, **Mr. Birtwisle** thanked delegates for accepting so completely the views put into the report by the Parliamentary and Local Government Committee. The Society accepted the general call for certain amendments of the Clean Air Act, 1956, and such steps as were available to this end were being taken. Points made in the discussion should not be accepted as in any way providing an excuse for local authorities to wait for these amendments before implementing as fully as possible the powers already available.

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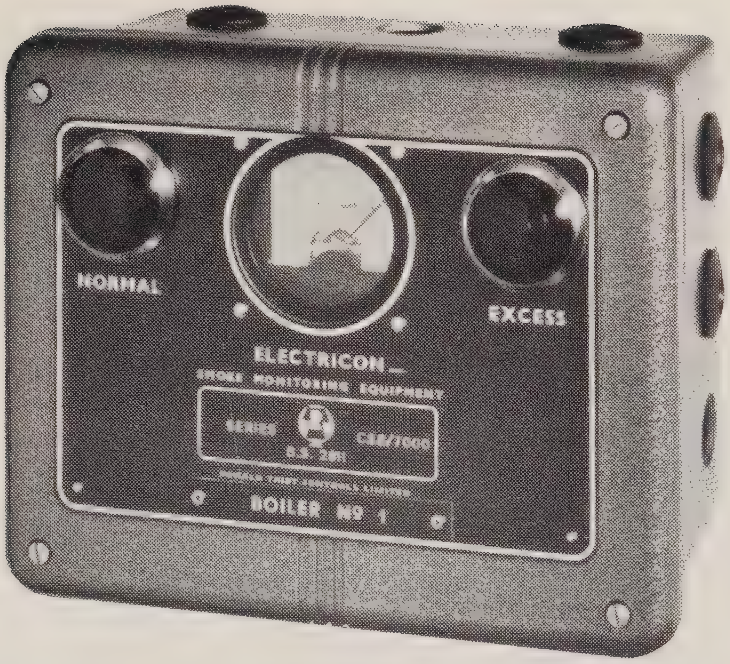

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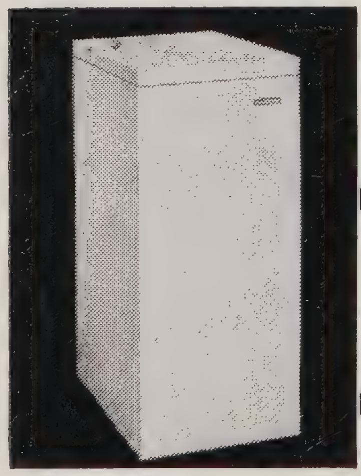

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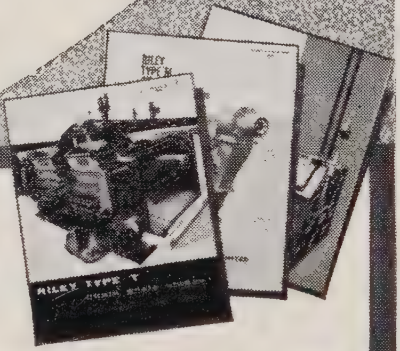

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Your Housing Department can now build two types of electric central heating into new homes:

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**Ministry of Housing and Local Government circular No. 69/63.*

The tomorrow things are electric—**and you can have them TODAY**

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Our representatives visit all parts of England and Wales at regular intervals and we can arrange interviews at any place or time to suit our customers' convenience.

A Message from the Mayor of Eastbourne

I AM pleased to send this message of welcome to you who will be delegates at the National Society for Clean Air Conference in Eastbourne this year.

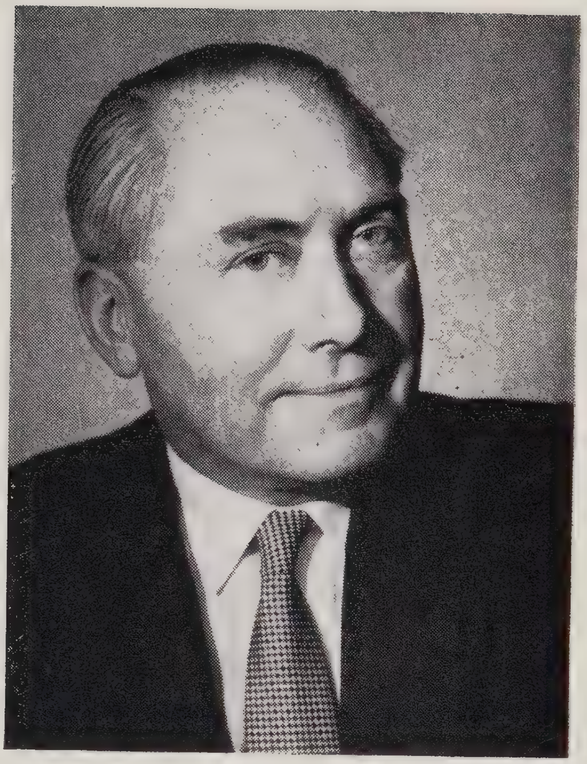
We are glad to place our excellent facilities at your disposal, and I know you will find the new Congress Theatre, which has been specially designed for your comfort, the ideal meeting place.

You are sure to notice the clean appearance of Eastbourne, its thoroughfares, promenades and beaches, and will realise why many visitors decide to make their home in this popular holiday resort.

As you each make your contribution to the success of your 1965 Conference may you also derive much benefit from experiences shared, and so help forward the important work of your Society.

K. J. Underhay

OPENING SESSION



In the Chair
Sir Alan Wilson, F.R.S.
President

Opening Address
R. J. Mellish,
M.P.
Joint
Parliamentary
Secretary
Ministry of
Housing and
Local
Government

Eastbourne

WHEN John Evelyn presented his "Fumifugium" to Charles II on 13 September, 1661, he little thought that Government action would follow so speedily. Two shillings per hearth per annum would now impose little restriction on the comfort of a fireside, but in less inflated times the Hearth Tax, imposed in 1662, bricked up many fireplaces. The Tax was of course not so much a first attempt at smoke abatement as another scheme to replenish the ever emptying royal coffers.

The Hearth Tax assessment for 1665 is of interest because it reveals, as national records show, that just three centuries ago there were a mere 130 houses in the parish of East Bourne: hardly enough for one side of the present Terminus Road. The manor of Bourne Place, which had twelve hearths, was owned by William Wilson, who was knighted for loyalty to the royal cause. He had, in fact, without regard to the atmosphere, lit bonfires on the links adjoining the manor to proclaim Charles II King. Bourne Place was purchased in 1724 by Sir Spencer Compton, Speaker in the House of Commons, who built up one of the largest estates in East Sussex and enlarged the Tudor manor into the present Georgian mansion of Compton Place.

In 1782 the estate passed to Lord George Cavendish, third son of the 4th Duke of Devonshire. By that time holidays by the sea were becoming fashionable, and when four of George III's children arrived to spend their summer holiday at Sea Houses (still on Marine Parade), Eastbourne rose on the waves of popular opinion until in 1804 "this little watering-place" boasted "the fullest season ever known". "Little" was no mean description because in 1801 there were no more than 243 houses and 1,668 inhabitants, and as late as 1851 the census figure only reached 3,433.

"*In a Manner Worthy*"

In the next fifty years, however, there was an incredible increase, and by 1901 Eastbourne had become the home of 53,653 people. The rising tide of prosperity created by the Industrial Revolution, which brought smog and smut to so many towns in England, had encouraged William Cavendish, who became 7th Duke of Devonshire in 1858, and John Davies Gilbert, the other principal local landowner, to put in hand the development of the parish, "in a manner worthy of its natural advantages and regardless of expense".

Until the mid-nineteenth century there were only two main roads, crossing between the thirteenth-century Lamb Inn and the Parish Church in the Old Town, but in the last half of that century many fine tree-lined roads spread across the green fields, named after towns around the Duke's estates: Buxton, Silverdale, Carlisle, etc. Attracted by such enterprise and by the beautiful situation of Eastbourne under the lea of the South Downs, many retiring from high government and military service built houses of character in the Meads. Fine promenades were laid in terraced walks to the foot of the Downs, and every natural feature was developed to advantage, giving Eastbourne that grace and charm which it still maintains.

The parades now stretch for three miles to Princes Park at the eastern end of the front, where there is a broad model yachting lake and sports' centre. The main floral parks are Hampden Park with its large lake and wild waterfowl, and the Manor House Gardens adjoining Gildredge Park. Here you will find the Towner Art Gallery. Near the foot of the Downs in an Italian Garden setting you can enjoy morning coffee all the year round at Holywell, and in the Grand Parade Band Arena at the centre of the sea front crack military bands play from Easter until October.

Congress Theatre

The new Congress Theatre, costing nearly half-a-million, is the town's most recent achievement. Essentially a theatre this building has been specially designed to provide the best possible conference atmosphere for speakers and listeners alike, and has given Eastbourne a firm lead in the Conference world. There is scope for every kind of entertainment, and the Congress Theatre is rapidly becoming a second home for Sadlers' Wells, the Royal Ballet, London Philharmonic Concerts and London Stage Productions. Opposite the Congress

Theatre, on the sea front, the recently built sun lounge and cafe at the Wish Tower provide extensive views of the eastern coastline away to Dungeness and of Beachy Head on the west.

Beachy Head

Beachy Head rises 575 feet above the sea. From the top of the sheer, white cliffs you can see neighbouring coastal resorts, and look far out across the English Channel where steamers ply from nearby Newhaven to the coast of France, or drop your gaze to the lighthouse like a pepperpot below. On the Downs the delights of open sea and country mingle, and salt-tanged air fresh blown from the Channel blends with the scent of Downland gorse and wild thyme. Over 4,000 acres of Downland have been purchased by Eastbourne Corporation, and you can freely roam or ride for miles on the shoulders of the hills which embrace Eastbourne and shelter it from prevailing winds.

Eastbourne's equable climate, brilliant sunshine record (the town has topped the Air Ministry's mainland list for unclouded sunshine for four successive years) and natural beauty enhanced by graceful planning, attract holidaymakers the world-over at all times of the year. Many who relax here on holiday decide to make Eastbourne their home, and although absence of heavy industry prevents some from living here during working life, the popularity of Eastbourne as a town for residence increases steadily.

The absence of heavy industry accounts for the clean appearance of the town, and the tonic air, neither relaxing nor bracing, is due not to a more stringent application of the Hearth Tax, but to Eastbourne's favoured position on the Sunny Sussex Coast. John Evelyn and those he inspired to seek a remedy for "The Inconveniencie of the aer and smoak of London" and elsewhere, might also claim some credit!

Are you well read on

CLEAN AIR?

See the Society's Bookstand in the
Exhibition for all the latest literature
including

Government Papers and Reports
NSCA Publications

For New Delegates

ABOUT THE SOCIETY

Those who are attending the Conference for the first time may wish to know more about the National Society for Clean Air. As we celebrated our Diamond Jubilee in 1959 with a special International Conference it will be seen that the Society has quite a long history. Starting in a very small way with but a handful of private individuals, the Coal Smoke Abatement Society was formed in 1899. It did valuable pioneering work and accomplished the first necessary stage of making it understood that clean air was not the impractical fad of a few cranks. It did much behind the scenes when the Newton Committee was set up, and co-operated with a provincial association that had been formed in 1909, the Smoke Abatement League of Great Britain. In 1929 the two bodies joined together to form the National Smoke Abatement Society.

This name was retained until 1958, when it was changed to the present one, and at the same time, to put its membership and finances on a recognized business footing, it became a Company Limited by Guarantee and not having a share capital. It is licensed by the Board of Trade to omit the word "Limited" from its name and is registered as a Charity with the Charities Commission. It is similarly recognized by the Board of Inland Revenue for income tax purposes.

The Society is a voluntary organization essentially subsisting on the subscriptions of its members, and it does not receive any official grant or subsidy. Its members include individuals, local authorities and firms, associations and other corporate bodies. Although local authorities—over 500—constitute the largest class of membership the corporate members make the largest class of subscriptions. The Society is governed by an Executive Council consisting partly of elected representatives of members on a divisional basis, and partly of the appointed representatives of national organizations in membership. The Divisions are: Scotland, North-West, North-East, Yorkshire, West Midlands, East Midlands, South-East, South Wales and Monmouthshire, South-West, and Northern Ireland. There are Divisional Councils of members, with their own committees and honorary officers, in each of the Divisions except the South-West.

The Society's objects are, in brief, to promote clean air by education, publicity and similar means, to encourage the adoption of means for clean air, and generally to help to create a public opinion in favour of these objects. Its main activities are the publication of a journal, Year Book and other literature, the holding of conferences and meetings, providing educational and publicity material, information and other services, and co-operating with others.

The Society and its parent bodies have many achievements to their credit, from pioneering the training of boilerhouse firemen and the regular measurement of air pollution to the conception and advocacy of smokeless zones and prior approval. More recently the Society has been successfully concerned with the problems of road vehicle pollution.

Today, with the Clean Air Act in force, the opportunities for useful activity by the Society are greater than ever before, and are in fact both needed and demanded more than ever before. But much remains undone because its income is only a tithe of what could be used to advantage. New members, and more new members, are needed—and if you, as a delegate to this conference, can help us to secure them you will be doing a very good turn to the cause of clean air.

National Society for Clean Air

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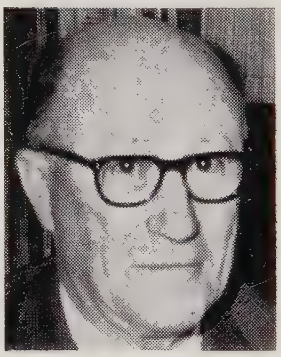

E. J. COUCKE

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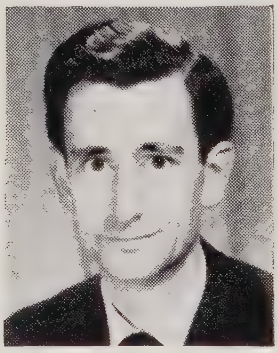

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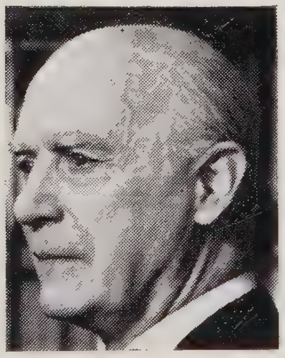

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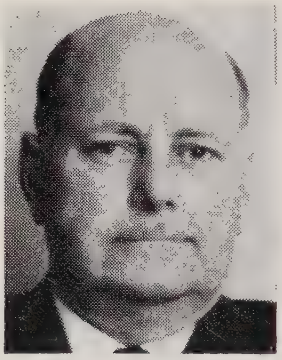

A. C. SAWORD

T. HENRY TURNER

Previous Conferences of the Society

1929	Buxton
1930	Leicester
1931	Liverpool
1932	Newcastle upon Tyne
1933	Sheffield
1934	Glasgow
1935	Bristol
1936	London (Science Museum)
1937	Leeds
1938	Cardiff
1943	London*
1945	London*
1946	Brighton*
1947	Edinburgh
1948	Cheltenham*
1949	Harrogate*
1950	Margate*
1951	Blackpool
1952	Portsmouth*
1953	Glasgow*
1954	Scarborough*
1955	Bournemouth
1956	Southport*
1957	Hastings*
1958	Llandudno*
1959	London (Diamond Jubilee International)*
1960	Harrogate*
1961	Brighton*
1962	Harrogate*
1963	Scarborough*
1964	Harrogate*

** Proceedings still available. For prices and other details see current Clean Air Year Book.*

Platform Who's Who

Allen, George O., M.A.P.H.I., A.M.Inst.P.C. Chief Public Health Inspector, Scunthorpe; Chairman, East Midlands Centre, Public Health Inspectors' Association.

Batey, J. W., D.P.A., M.I.Mar.E., F.R.S.H. Chief Smoke Inspector, Sheffield and District Clean Air Committee. Formerly marine engineer.

Beaumont, S. C., M.I.Mar.E., M.R.S.H., M.A.P.H.I. Chief Smoke Inspector, Birmingham. Member of Executive Council, East Midlands Division, N.S.C.A.

Betz, Erwin. Managing Director of Kavag and member of Board of the Catalytic Combustion Company. Obtained MS.CHE. and BBA in New York.

Bourne, W. H. General Manager, London and Counties Coke Distributors' Association, and Executive Officer, National Federation of Coke Contributors' Association.

Brewster, H. R. in charge of Domestic Markets Division, Shell-Mex and B.P. Ltd.

Bruce, R. N., O.B.E., T.D., B.A., B.Sc., M.I.Gas.E. Chairman, South Eastern Gas Board. President, British Road Tar Association.

Cayton, S., F.R.S.H., M.A.P.H.I., M.Inst.F., M.Inst.P.C. Chief Public Health Inspector and Cleansing Superintendent, West Bromwich; Chairman, Conference Committee, N.S.C.A.

Charrington, Sir John. President, Charringtons. President, National Federation of Coke Distributors' Associations.

Cohen, Stanley E., C.C., F.R.S.H. Honorary Treasurer, N.S.C.A.; Member of the Clean Air Council; Member and Chief Commoner of the Court of Common Council.

Coucke, Edouard J., Colonel (*retired*), engineer, and since 1958 Director of the "Fund for Study and Research in Road Safety".

Goodfellow, James, F.R.S.H., M.A.P.H.I. Chief Public Health Inspector, Leeds; Chairman of Executive Council and Hon. Secretary, Yorkshire Division, N.S.C.A.

Hodgson, John M. Qualified as a mechanical engineer and specialized in industrial dust exhaust and collection. Has spent about 12 years in this industry as Technical Director of Filter-Heat Ltd. and General Manager of Collectron, Ltd.

Ireland, F. E., B.Sc., F.R.I.C., M.I.Chem.E., M.Inst.F. Chief Alkali Inspector.

Melling, C. T., C.B.E., M.Sc.Tech., M.I.E.E., M.I.Mech.E., F.Inst.F. Deputy Chairman, Electricity Council. Member of the Clean Air Council.

Mellish, R. J., M.P. Joint Parliamentary Secretary, Ministry of Housing and Local Government; Member for Bermondsey.

Otty, Eric, M.Inst.F. Head of Special Projects Branch, National Coal Board.

Parker, Dr. Albert, C.B.E., D.Sc., M.Inst.Chem.E., M.Inst.Gas.E., F.R.S.H. Immediate Past President of the Society; Former Director, Fuel Research Station, D.S.I.R.; Executive Vice-President, Royal Society of Health; Hon. Secretary, British National Committee, World Power Conference.

Reid, William, Ph.D., B.Sc., F.Inst.F. Chairman, Northumberland and Durham Division, National Coal Board. Past President of the Institution of Mining Engineers, Fellow, Royal Society of Edinburgh.

Richards, J. E., M.A.P.H.I., A.M.Inst.F. Senior Public Health (Smoke) Inspector, Manchester.

Saword, A. C., D.P.A., F.R.S.H., F.A.P.H.I. Chief Public Health Inspector, Kingston-upon-Hull; Joint Deputy Chairman, Executive Council, and Chairman, Yorkshire Division, N.S.C.A.

Turner, T. Henry, M.Sc., M.I.Mech.E., M.I.Loco.Eng., F.I.M. Individual Member; Joint Deputy Chairman, Executive Council, N.S.C.A.

Underhay, Councillor Mrs. K. J., J.P. Mayor of Eastbourne.

Wicken, A. J. Head of Health Surveys at AGB Research Ltd. Graduated in Psychology, Philosophy and Physiology at Oxford.

Wilson, Sir Alan, F.R.S. President of the Society; Chairman, Glaxo Group Ltd. Was Chairman of the Government Committee on Noise.

Conference Information

Meeting Places

All Conference sessions will be held in the Congress Theatre. The "get-together" of members and delegates will take place in the Winter Garden Pavilion.

Registration

A Registration Card will be enclosed with this Handbook, and you are requested to complete this and hand it in at the Society's Information Counter, at the first session attended.

Discussions

Those wishing to speak in the discussions should complete and hand in a printed Discussion Card which may be obtained from the Information Counter or Steward in the hall. All speakers are requested to: (*a*) condense their remarks as much as possible, and (*b*) confine them to the specific questions raised in the papers being discussed. The time allowed for contributions will normally be limited to three minutes. Those who take part in the discussions and wish to have their remarks recorded are asked to send a condensed copy of their remarks, in reported speech, to the Director not later than 5 November.

Resolutions

The following conditions for the submission of resolution are stipulated by the Executive Council:

(*a*) Any resolution it is desired to submit must be relevant to matters under discussion at the conference.

(*b*) No resolution may be moved except by prior approval of the Resolutions Committee.

(*c*) A copy of the proposed resolution must be received by the Director not later than 10.30 a.m. on Wednesday, 27 October, or preferably by post (at the Society's offices) on or before Friday, 22 October.

(*d*) Resolutions will be moved at the end of the Friday morning session only.

List of Delegates

A printed list of delegates will be available in the Conference Office in the Exhibition Hall.

Proceedings

All the Papers, Addresses, discussions and any resolutions adopted will be published in volume form as the

Proceedings of the Conference. A copy will be forwarded free of charge to all registered delegates and extra copies will be available at about 30s. each.

Bookstall

The Society's, H.M.S.O., and other publications will be displayed on a bookstand in the Winter Gardens. They will also be displayed in, and may be purchased from, the Conference Office and Information Counter in the Congress Theatre.

Conference Office

The Society's Conference Office will be in the Exhibition Hall, where members of the Staff will be pleased to answer inquiries. The Accountant will be at the office for the receipt of fees and other payments. There will also be an Information Counter in the Congress Theatre entrance.

The Exhibition

The National Clean Air, Fuel Efficiency and Domestic Heating Exhibition—the eighth to be organized by the Society in conjunction with its annual conference—will be in the Congress Theatre Restaurant and Winter Gardens.

All delegates should make a point of visiting the exhibition. For hours of opening see page 26. Particular attention is drawn to the Society's own exhibits which will include the latest publicity aids available to local authorities and all concerned with the promotion of clean air. All exhibition inquiries, including information about the International Exhibition at the Royal Horticultural Society's New Hall, Westminster, London, S.W.1, 4 to 7 October 1966, should be addressed to the Exhibition Organizer, John L. G. Longstaff.

Visits and Tours

Details of works visits and tours, etc., for delegates' ladies have been sent to delegates. Any further information about the arrangements will be announced or displayed at the conference and will be available at the Conference Office. Inquiries should be made to the Assistant Secretary, Alan A. Mister.

Golf Tournament

A golf tournament will be held on the afternoon of 27 October on the Royal Eastbourne Course for the trophy presented by the Solid Smokeless Fuels Federation for annual competition at the Conference. The yearly holder will receive a suitably inscribed tankard presented by the SSFF.

Postal Facilities

A G.P.O. self-service post office will be located in the Winter Gardens.

Bank Facilities

Full banking facilities will be available to all attending the Conference or Exhibition from the District Bank Ltd., at Stand E.6 in the Exhibition Hall.

Rail Travel

There will be a British Rail Inquiry Bureau in the Exhibition Hall, near the Conference Office, where information about rail travel, seat reservations, etc., may be made.

Inquiries relating to reduced fare rail tickets should be addressed to: Advance Travel Ltd., 7-13 Grove Road, London, E.3.

Photography

The official photographer is Fox Photos Ltd., who will provide a 24-hour service. Delegates and visitors are advised not to give orders for photographs to any unauthorized photographer or agent.

General Inquiries

The Society's staff at the Conference Office and Information Counter will be pleased to assist with any inquiries on matters not mentioned above.

Conference Programme

MEETING PLACES

All Conference Sessions	**Congress Theatre**
Exhibition	**Winter Garden**
Informal Gathering (Monday)	**Pavilion, Winter Garden**
Conference Luncheon (Thursday)	**Burlington Hotel**
Civic Concert (Thursday)	**Congress Theatre**

For details of Authors, Speakers, etc., see "Platform Who's Who", page 23

Monday, 25 October

Evening

From 8.30 Informal Gathering.

Tuesday, 26 October

Morning

10.30 Opening Session.

Chairman: The President, Sir Alan Wilson, F.R.S.

Civic Welcome by the Worshipful the Mayor of Eastbourne, Councillor Mrs. K. J. Underhay, J.P.

Address and Opening of the Conference by R. J. Mellish, M.P., Joint Parliamentary Secretary, Ministry of Housing and Local Government.

The Presidential Address.

Vote of thanks by the Hon. Treasurer, Stanley E. Cohen.

11.45 Conclusion of Session. The Principals in the Platform Party will proceed to the Exhibition, which will be formally opened by Mr. Mellish.

Afternoon

Chairman: James Goodfellow

14.30 Papers on (*a*) Successes with Smoke Control:
Sheffield: J. W. Batey
Scunthorpe: G. O. Allen
Manchester: J. Richards

(*b*) Solid Fuel Distribution and Supply Problems
(*i*) E. Otty
(*ii*) W. H. Bourne

Discussion to be opened by Sir John Charrington

16.30 approx. Close of Session.

18.00 Exhibition closes.

Wednesday, 27 October

Morning

9.30 Exhibition opens.

Chairman: Dr. Albert Parker, C.B.E.

10.00 Papers on (1) A Recent Survey's Findings Concerning Air Pollution and Mortality from Lung Cancer and Bronchitis,
by A. J. Wicken

(2) Odour Control by Catalytic Combustion,
by E. Betz

(3) Experience in Road Vehicle Pollution in Belgium,
by E. Coucke

Discussion.

12.30 Close of Session.

Afternoon

Works Visits, etc.

21.30 Exhibition closes.

Thursday, 28 October

Morning

9.30 Exhibition opens.

Chairman: A. C. Saword

10.00 Papers on New Horizons in Domestic Heating.

(1) Progress with oil, with particular reference to District Heating and Central Distribution,
by H. R. Brewster

(2) The Future for Gas,
by R. N. Bruce

(3) Progress with solid fuel with particular reference to District Heating,
by Dr. William Reid, C.B.E.

(4) The Future for Off-Peak Electricity,
by C. T. Melling, C.B.E.

Discussion.

12.30 Lunch adjournment.

12.45 for **13.00** Conference Luncheon.

Afternoon

Chairman: T. Henry Turner

14.30 Industrial Problems.

Papers on (1) The Selection of Industrial Dust Collection Equipment,
by John Hodgson

(2) Chimney Heights—Progress and Problems since the Memorandum,
by S. C. Beaumont

Discussion.

16.30 approx. Close of Session.

18.00 Close of Exhibition.

Evening

20.30 Civic Concert (*by invitation*).

Friday, 29 October

Morning

9.30 Exhibition opens.

Chairman: Stanley Cayton

10.00 Papers on Unresolved Problems in Air Pollution

(1) by F. E. Ireland

(2) Report from the Parliamentary and Local Government Committee, presented by the Chairman, E. M. Birtwisle

Discussion.

12.15 Any resolutions: General Vote of Thanks, etc.

12.30 Close of Conference and Exhibition.

THE INTERNATIONAL CLEAN AIR CONGRESS

PATRON: H.R.H. THE DUKE OF EDINBURGH, K.G., K.T.

London: 3-7 October, 1966

Organized by the

NATIONAL SOCIETY FOR CLEAN AIR

for the

INTERNATIONAL UNION OF AIR POLLUTION PREVENTION ASSOCIATIONS

For details so far available see *Smokeless Air*, Autumn, 1965, or the First Notice, and Invitation to propose Papers—available at the Conference Office, Eastbourne, on request.

A more detailed notice, with registration form for delegates, will be sent to all members of the Society, and to all Local Authorities and interested organizations in April next.

The Clean Air Exhibition to be held in conjunction with the Congress will also be International. Stand space (in the New Horticultural Hall, Westminster) is limited and is already being reserved. Firms and organizations interested in participation should make early contact with the Society's Exhibition Officer, John L. G. Longstaff.

Arnold Marsh, *Director*

TOTAL SERVICE

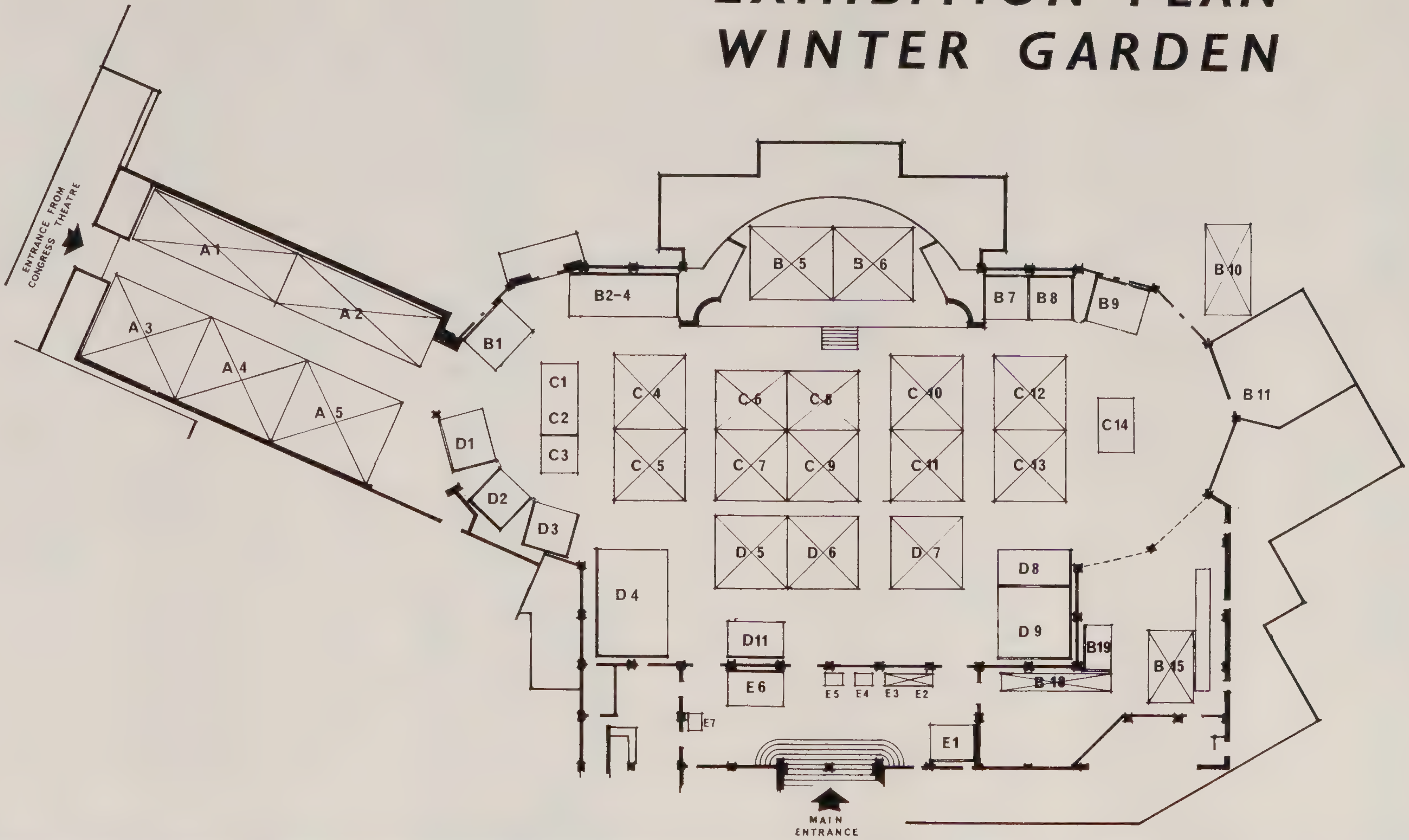
from the world's fastest-growing international oil company

- ✱ Fuel Oil Storage Advisory Service
- ✱ Cost Evaluation for new installations or conversions
- ✱ Plant Testing and Maintenance facilities
- ✱ Also TOTAL Heating Oils – super-refined for cleanest burning, maximum efficiency

See TOTAL on stand No. D.9.

TOTAL OIL PRODUCTS (G.B.) LTD.
SEYMOUR MEWS HOUSE · WIGMORE ST · LONDON W1

EXHIBITION PLAN
WINTER GARDEN



Barnsley Sunbrite

provides

heat for industry

with graded coke nuts for furnaces
and

heat for the home

with No. 2 special cut coke nuts
for boilers and stoves

Barnsley BurnBrite

the new smokless fuel for approved open fires
provides

heat with economy

The Quality Fuels manufactured by
The Barnsley District Coking Co. Ltd.
of Worsbrough, Nr. Barnsley – Barnsley 2264

CLEAN AIR EXHIBITION

Winter Garden, Eastbourne, 26–29 October, 1965

Hours of Opening

Tuesday, 12.00 - 18.00	**Wednesday, 9.30 - 21.30**
Thursday, 9.30 - 18.00	**Friday, 9.30 - 12.30**

CATALOGUE

The information given in this list has been supplied by the Exhibitors and no responsibility for any of the statements or descriptions can be accepted by the National Society for Clean Air.

Stand No.

B1 THE BARNSLEY DISTRICT COKING COMPANY LIMITED OF WORSBROUGH, near Barnsley. (Telephone: Barnsley 2264).

Our Stand this year is an eye-catching display framing "Barnsley BurnBrite" burning in both a standard approved open fire and a convector room heater with back boiler. The purpose of this display is to demonstrate to all who visit our Stand how versatile this new improved version of our smokeless fuel is.

"Barnsley BurnBrite", in its new form, has all the excellent advantages of the original fuel having high heat output, low ash, no spitting and long lasting properties or, in other words, "heat with economy" but in addition, it now lights easily and has novel, long leaping, attractive blue flames.

"Barnsley BurnBrite" is a fuel which gives outstanding service on fires and room heaters and is widely available in England, Scotland and Wales. The young members of our Staff on our Stand will willingly give specific details of distributors of the fuel and also details of the appliances in use which were provided by Redfyre Limited whom we thank for their kind co-operation and assistance.

B9 BAXI, RICHARD BAXENDALE & SONS LTD., Bamber Bridge, P.O. Box 52, Preston, Lancs.

Baxi will be showing an entirely new open fire "The Fantom" on their stand. "The Fantom" has been specifically designed for use in smoke control areas and successfully overcomes some of the major obstacles encountered in supplying and fixing suitable appliances.

Designed to give easy lighting, fast recovery and ability to burn all fuels over a wide range of burning rates, "The Fantom" is a low cost open fire that can be installed in under an hour to an existing fireplace with or without back boiler.

"The Fantom" incorporates a built-in fan which supplies sufficient draught to burn all solid fuels including the harder cokes and which is infinitely controllable within the range required for normal domestic purposes. "The Fantom" is demonstrated under-fire, burning Sunbrite. Additionally Baxi have displays of their full range of Baxi underfloor draught fires and of their Gas Warm Air Heater.

B3 **F. E. BEAUMONT LTD., 475-493 Rathgar Road, London, S.W.9. (Telephone: BRIxton 4066. Telex: 25837 (Beaumont London). Telegrams: Beaustacks London Telex).**

Apart from general items of interest depicting the equipment used in the erection and maintenance of steel and brick chimneys, F. E. Beaumont Ltd. are exhibiting a BEAUVENT steel chimney fitted with BEAUVAL aluminium insulating cladding.

F. E. Beaumont Ltd. are exhibiting a model of a concrete structure carrying three BEAUVENT mild steel chimneys serving four 35,000 lb. per hour and one 14,000 lb. per hour Richardson Westgarth boilers.

One chimney being 200 ft. high from ground level by 2 ft. 4 in. i.d. and two chimneys 200 ft. high from ground level by 5 ft. 5 in. i.d.

The three chimneys and flues back to the boilers are to be fitted with BEAUVAL aluminium insulating cladding after erection at the University of York.

Also on the stand will be a model of the CLEMENTS BEAUVENT CHIMNEY designed with an outer shell to carry the structural load which contains a number of insulated inner chimneys so that each boiler has its own chimney. Each inner chimney can be sized correctly for the boiler concerned and maximum gas velocity can be obtained at all times.

Standard BEAUVENT chimneys are manufactured on a production line basis, unique in the industry, and are at present equipped to manufacture from $\frac{1}{4}$ in. thick M.S. Plate varying in diameter from 12 in. to 60 in. in 3 inch increments, and in height from 20 ft. to 100 ft. in 5 ft. increments. A total of 259 BEAUVENT standard chimneys which more than adequately cover the requirements of all types of boilers within this diameter range.

F. E. Beaumont Ltd. also design, manufacture and erect individual chimneys to customer's requirements.

E2 and E3 **CANCER INFORMATION ASSOCIATION, (Hon. Secretary, Malcolm Donaldson, M.A., F.R.C.S., F.R.C.O.G., F.I.H.E.), 6 Queen Street, Oxford. (Telephone: Oxford 41305).**

The object of this Association is to diminish 'fear and ignorance' among the public concerning Cancer and thus to persuade patients to consult their doctor at a time when the disease is still curable.

About 100 lectures are given each year to Women's Institutes, Townswomen's Guilds, Rotary Clubs, etc. It also runs a campaign against Cigarette smoking among schools and Youth Clubs.

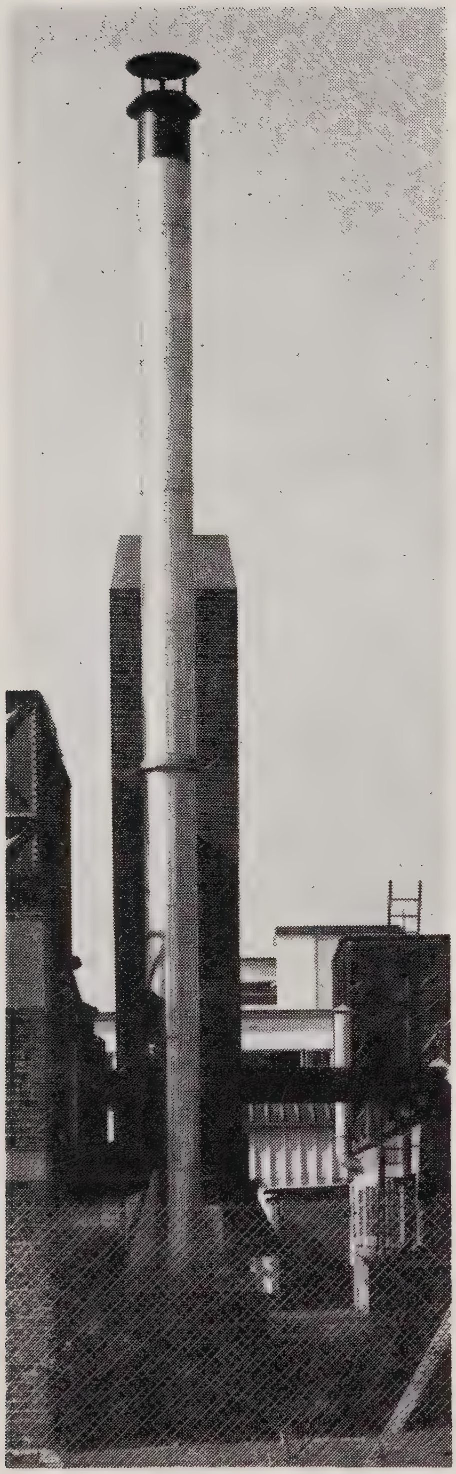
The present exhibition shows the nature of Cancer, the Diagnosis and Treatment of the disease.

Clean Air will undoubtedly make the Lungs less prone to Cancer.

F. E. BEAUMONT LTD.

465/483 RATHGAR ROAD · LONDON · S.W.9

BRIxton 4066 Telex 25837



(* Registered Trade Marks)

Manufacturers and Erectors of

***BEAUVENT STANDARD STEEL CHIMNEYS**
In ¼ in. m.s. plate varying in diameter from 12 in. to 60 in. in 3 in. increments and from 20 ft. to 100 ft. in height, in 5 ft. increments, cover the requirements of all types of boilers within this diameter range

***BEAUVENT STANDARD STEEL CHIMNEYS**
can be fiitted with *BEAUVAL ALUMINIUM INSULATING CLADDING to solve corrosion and smut emission problems

Specialists in all types of chimneys to suit individual requirements

---

See us on Stand No. C.3

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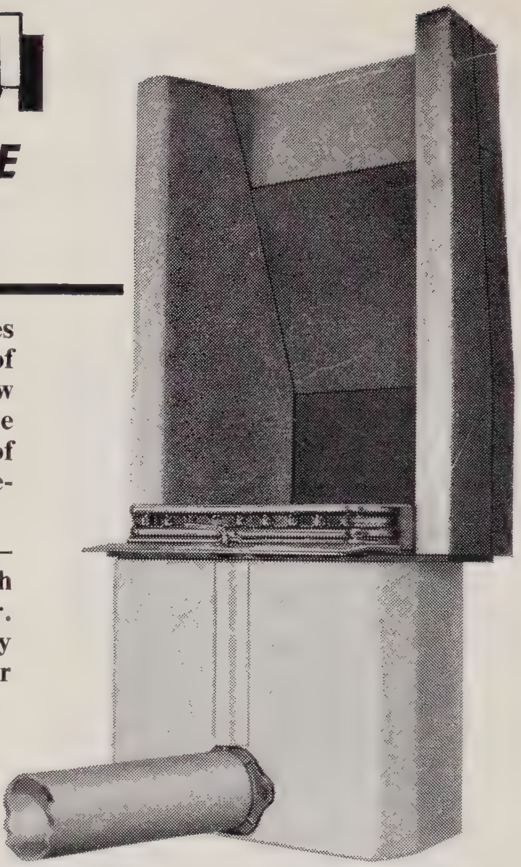
*Photograph of a 35 ft. high by 1 ft. 6 in. dia. *Beauvent Standard Steel Chimney fitted with a *Beauval Aluminium Insulating Cladding at the Central Laboratories of the Shell International Petroleum Co. Ltd., at Egham, Surrey*

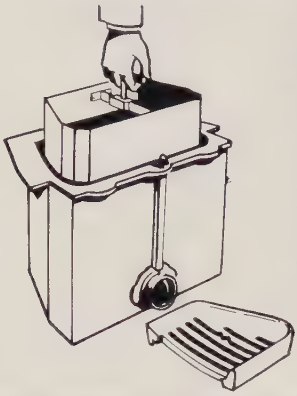
The SUNBEAM

UNDERFLOOR DRAUGHT FIRE

The CLEANER, BETTER WAY TO ECONOMIC HEATING !



Approved by the Domestic Solid Fuel Appliances Approval Council, it has every advantage of orthodox underdraught fires but priced far below that of any other make. The Sunbeam burns all types of solid fuel particularly smokeless.

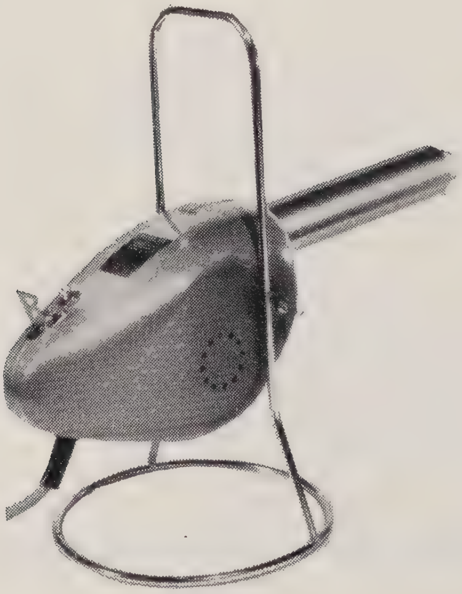


Three models are available—(1) As illustrated. (2) With Domestic Type back boiler. (3) High Output Boiler. Easy clean, deep lift-out ashbox for "once-a-week" cleaning.

WRITE FOR FULL DETAILS OR FOR YOUR NEAREST DEALER TO: **CHATWINS LIMITED** ALBION STREET TIPTON . STAFFS

INSIST ON THE MATCHLESS Best ELECTRIC FIRELIGHTER

£6 . 15 . 0



Ignites every type of fuel without use of wood, paper, etc.

No worries—clean hands.
Safety switch with removable key.

Neon warning light.
Can be used from an earthed 5 amp. socket.

Incorporates recommendations of the new British Standard Specifications.

Approved by the British Electrical Approval Board.

* * *

BEST PRODUCTS LIMITED
FELIXSTOWE • • SUFFOLK

Stand No.

B2, B3 and B4 CANNON INDUSTRIES LTD., Deepfields, Bilston, Staffs. (Telephone: Bilston 43161).

Cannon (recognised as leaders in the design and development of Space Heaters and Domestic Cookers) introduce their Revolutionary Functional breakthrough in Room Heating and structural design—the "SLIMLINE".

The first and only Inset Radiant convector Gas fire, "Slimline" is designed to be built into any "Panel" or "Hearth" type Fire surround. Alternatively, combined with a wood frame it becomes an attractive freestanding fire for independant installation to an existing fireplace surround and, *most important*, when a new fire surround is fitted "Slimline" may be readily built into it.

A "period type" fender, interchangeable with the standard pattern on either the Inset or Freestanding models for hearth fitting, is particularly suitable for use with stone or marble surrounds.

GasMiser "Slimline" will effectively heat from the smallest to the largest room in the coldest of weather conditions—maintaining Body Heat comfort at the very lowest of cost.

B5 and B6 CENTRAL ELECTRICITY GENERATING BOARD, Sudbury House, 15 Newgate Street, London, E.C.1. (Telephone: CITy 1202).

The Central Electricity Generating Board's exhibit presents a special feature in the form of an industrial landscape feature, animated to illustrate the value of electricity in promoting clean air.

The stand contains a "cinema-ette", presenting films explaining some of the Generating Board's research programmes on the avoidance of air pollution.

A working model demonstrates the effectiveness of electrostatic precipitation at modern power stations, where 99·3 per cent of all solid particles are removed from chimney gases before they are discharged into the atmosphere.

Clean and "polluted" 275,000 volt insulator strings are on display to illustrate how electricity supply breakdowns can be caused by severe air pollution.

All questions on electricity supply—"Tomorrow's Power Today"—will be dealt with by Central Electricity Generating Board staff who will be in attendance throughout the exhibition.

D8 CHATWINS LTD., Albion St., Tipton, Staffs.
Electrical Division

ENCHANTRESS 3 k.w. HEAT STORAGE FIREPLACE. Revolutionary new design in the thermal storage heating field. RECOMMENDED BY E.D.A. and Approved by all Electricity Boards. USES OFF PEAK ELECTRICITY and designed to simulate a standard 48 in. Fireplace with a 16 in. opening permitting the use of an electric on-peak Hearth Type Fire to give extra quick heat as and when required.

Alternative types of Enchantress Appliances on display:
HEARTH INSET FIRE. RADIANT TYPE. 2 k.w. and 3 k.w.

Coal or Log Effect.
ROYAL INSET. FAN HEATER TYPE. 3 k.w. Coal or Log Effect.
REPLICA FUEL EFFECT ONLY. Coal or Log Effect.
WOODGRAIN CONVECTOR. 2 k.w.
"NON-FLUID" RADIATOR. 1 k.w. and 1½ k.w.

Solid Fuel Division

SUNBEAM HOME HEATER. Introducing the design of tomorrow in the Solid Fuel Heating Field. So beautifully attractive with a matching performance. Fully Approved. High output boiler model giving an *official output* of over 20,000 B.T.U.'s per hr. and 1,600 cubic feet of radiation.

SUNBEAM UNDERDRAUGHT FIRE. Undoubtedly the most competitive appliance of its type on the market. Designed specifically for schemes with high quality and performance in mind. Three different models. Two piece bottom grate and ultra deep firebox are heat resistant metal clad for extended life.

SUNBEAM CLEAN-AIR FIRE. Fully Approved and designed for smoke control areas at the lowest possible price. Extra large ashpan. Supplied with or without gas ignition tube. Available in two designs and three finishes.

SUNBEAM SUPERIOR COOKER. Needs no introduction. As its name suggests a superior Appliance. The only one providing cooking—heating—hot water and radiators. Available in two different colours with many optional extras.

All the aforementioned Appliances, both Electrical and Solid Fuel, are fully Approved and suitable for Clean Air Zones.

A3 and A4 **COALITE & CHEMICAL PRODUCTS LIMITED, P.O. Box No. 21, Chesterfield, Derbyshire. (Telephone: Bolsover 2281).**

In the setting of a bungalow chalet various types of open fires and a Solid Fuel cooker clearly demonstrate the versatility and flexibility of "Coalite"—the ideal solid smokeless fuel for every type of domestic grate, ancient or modern, equally suitable for openable or closable stoves and domestic hot water boilers.

Mrs. 1965's desire for a solid smokeless fuel that is easily ignited in the ordinary way with paper and sticks, firelighter, or gas poker—that burns cheerfully and merrily with a flame and gives luxurious radiant heat with maximum comfort and economy is fully satisfied by "Coalite".

"Coalite" which is highly reactive will laze or blaze according to the housewife's requirements. It may be allowed to laze throughout the night or on other occasions when full heat is not required but will immediately respond when the air regulator is opened to give a luxurious friendly fire.

"Coalite" is equally as suitable as best house coal for all open fires, whether for use on an old fashioned fret grate or the latest inset convector fire and can be obtained from all leading coal merchants in Smokeless zones or White Areas.

For 50 years the demand for "Coalite" has been growing

More COALITE for open fires in smokeless zones

Expanding production — increasing supplies

Coalite, the modern smokeless coal, is recognised as a perfect fuel for consumers living in smokeless zones. It burns warm and well; without clinker—and without smoke or soot. Clean air—and yet a friendly open fire. No need for expensive conversions. Coalite Nuts should be used for cookers, stoves and boilers.

To meet the demands of the new Smokeless Zones, 'Coalite' and Chemical Products Limited have been expanding fast. Twelve new batteries of carbonising retorts have been commissioned since November, 1963 —boosting output by 42%. Now work has commenced on a new Plant at Grimethorpe in Yorkshire which will become operative in the late Autumn of 1966, giving a further major increase in supplies.

Coalite is the perfect answer to smokeless zone problems

'COALITE'

THE MODERN SMOKELESS COAL

CALL THE CUC

for advice on solid fuel domestic heating

C.U.C. stands for Coal Utilisation Council. It has been in existence for over 30 years, and since the war has been the recognised official authority on the domestic use of solid fuel.

The C.U.C. can offer technical advice on every aspect of solid fuel domestic heating. Technical experts are available in each of the Council's regions.

FOR FURTHER INFORMATION

visit Stand No. C.8—C.9

Issued by the Coal Utilisation Council, 19 Rochester Row, London, S.W.1

year after year and continues to increase—factual evidence that Mrs. 1965 still prefers the traditional open fire for heating her room and as a focal point for her family during the long Winter evenings. She knows that the open fire gives her luxurious radiant heat and gentle ventilation that together ensure maximum comfort and health for her family.

Mrs. 1965 is price conscious and a discerning buyer so when ordering "Coalite" she accepts that one buys by weight but consumes by volume making "Coalite" cheapest in the long run.

Don't forget—"Coalite" which is an Approved Smokeless Coal, will burn satisfactorily in any type of grate or appliance without the expense of alteration.

C8 and C9 **COAL UTILISATION COUNCIL, 19 Rochester Row, London, S.W.1., and at Aberdeen, Birmingham, Bristol, Cambridge, Cardiff, Edinburgh, Glasgow, Leeds, Manchester, Newcastle-upon-Tyne, Nottingham, Plymouth, Reading and Tunbridge Wells.**

The Coal Utilisation Council is a non-trading organisation representative of the National Coal Board and other producers of solid fuel, fuel distributors, and manufacturers, distributors and installers of domestic heating appliances. Its aim is to promote the efficient domestic use of all solid fuels. In existing or proposed Smoke Control Areas the Council's policy is to retain the domestic market for solid fuels, by the use of solid smokeless fuels in modern approved appliances, examples of which are on display. The Memorandum on Smoke Control Areas published by the Ministry of Housing and Local Government quotes the C.U.C. as one of the organizations from which Local Authorities contemplating the establishment of Smoke Control Areas may obtain advice and assistance.

On display is a range of the latest type of tested and approved appliances including deep ashpit open fires, room heaters, domestic and central heating boilers. Working exhibits will be a modern inset open fire, a deep ashpit fire with underfloor air supply, an inset room heater, and a freestanding room heater.

Information is available on the stand on C.U.C. Training Courses, available free or charge, for Public Health Inspectors, Housing Officers, Clerks of Works, Brickwork Instructors, etc. These courses deal with the various types of solid fuel heating appliances and the problems arising in their installation.

The C.U.C. publishes jointly with the Solid Smokeless Fuels Federation the official List of Appliances approved by the Domestic Solid Fuel Appliances Approval Council, from which solid fuel burning appliances for replacement in Smoke Control Areas must be chosen. Copies of the List and of various publications issued by the Council may be obtained on the Stand.

The Women's Advisory Council on Solid Fuel has an information section on the stand and members of the staff will be present to discuss with delegates any assistance which can be given to

Stand No.

local authorities promoting smoke control areas through women's meetings etc.

E6 DISTRICT BANK LIMITED, Head Office: 17, Spring Gardens' Manchester, 2.

Founded in Manchester, in 1829, as the Manchester and Liverpool District Banking Company, District Bank (the shorter title was officially adopted in 1924) is the oldest joint stock bank in England and Wales.

During the course of the 19th Century many branches were established, mainly in Lancashire, Cheshire and Staffordshire. The first thirty years of the present century were years of steady expansion for the bank, emphasis being placed upon consolidation of the already substantial business which had been built up in the North West. Since then, however, in keeping with developments in the industrial and commercial life of the country, many branches have been established outside this area.

Today the total assets of District Bank, which in 1962 became a member of the National Provincial Bank group, exceed £360,000,000. Over 580 branches are spread over the length and breadth of the country and provide a comprehensive, up-to-date service for many business, professional and private customers.

Recent developments include the installation of an electronic computer which ultimately will handle the accounts of many thousands of customers, at the bank's Piccadilly (Manchester) branch and the announcement of plans for a new Head Office of the bank which is to be built on the site of the present branch at 55-57, King Street, Manchester, which is to be demolished in the near future.

Exhibitors and visitors are invited to make full use of the Banking Facilities available at our branch at Stand No. E6. Our representatives will be pleased to give you help and information.

D11 DYMO LTD., Browells Lane, Feltham, Middlesex.

DYMO offers the ideal system for instant on-the-spot identification, clear coding and personalization. A range of high quality hand tools embosses crisp, white letters on vinyl self-adhesive tape in ¼ in., ⅜ in., ½ in., and ¾ in. widths and 14 colours including the new Woodgrain. There is also a tool for embossing metal tapes.

Complimentary to this range are Key and Luggage Tags, Prices, Place and Door Markers and Lapel Badges.

This simple system increases the efficiency of any establishment, and economically caters for changes in equipment, personnel and detail.

Completely new in this country is the Dymo M-75 Desk/Bench embossing tool, embossing clear white letters and characters on ¾ in. vinyl self-adhesive tape in 6 colours—Red, Blue, Green, Brown, Black and Woodgrain. The ½ in. high letters are ideal for signs and notices and there is a range of Desk, Door and Place accessories.

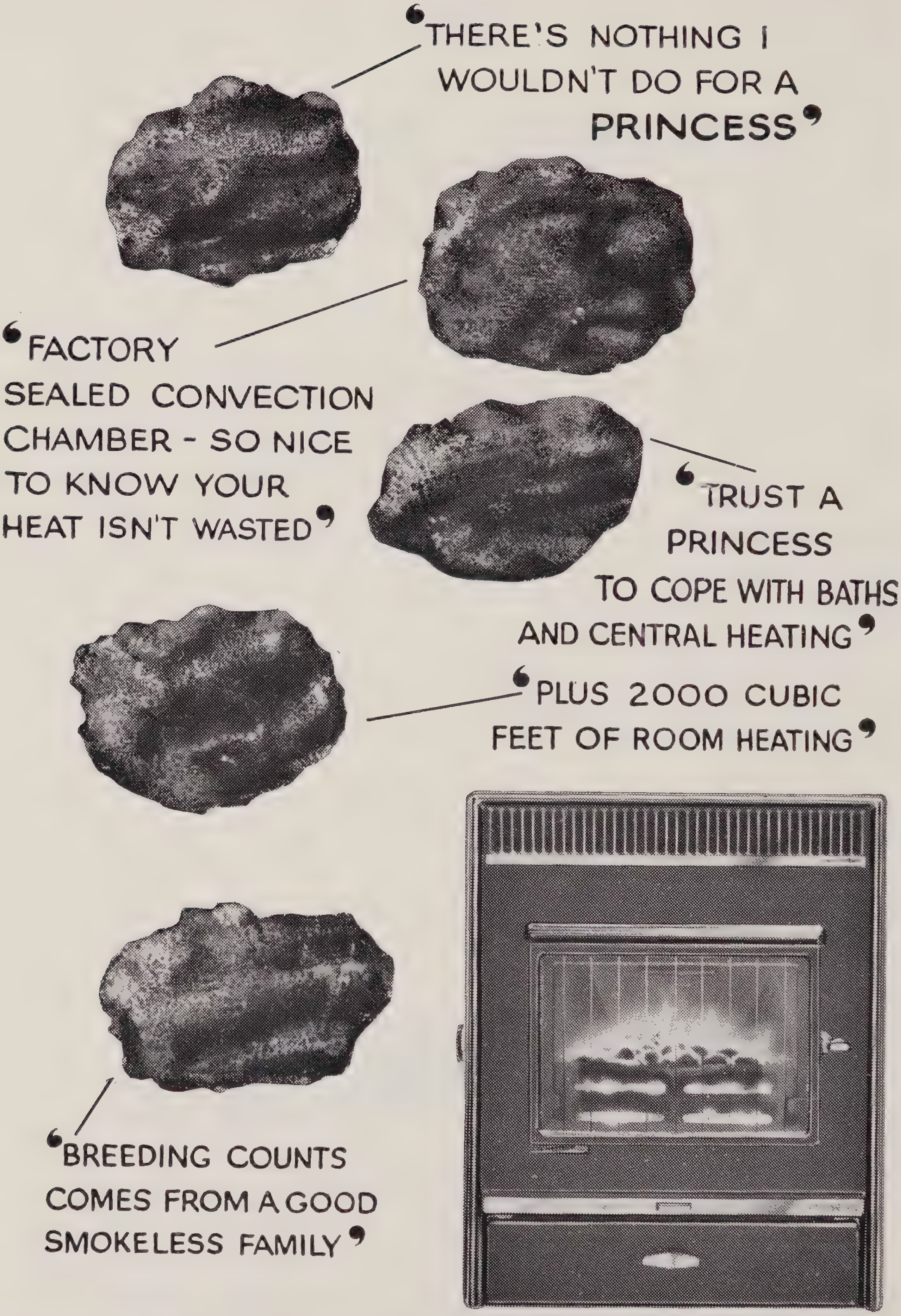
Banking Facilities
at the
Clean Air, Fuel Efficiency and Domestic Heating Exhibition

Exhibitors and visitors are cordially invited to make full use of the banking facilities which we are providing at the Exhibition from the 26th to the 29th October. Our representatives will be pleased to see you.

DISTRICT BANK
LIMITED
1829

OVER 580 BRANCHES

EASTBOURNE BRANCH: 56 SOUTH STREET
Manager: Mr. C. D. L. Gee


‘THERE’S NOTHING I WOULDN’T DO FOR A PRINCESS’
‘FACTORY SEALED CONVECTION CHAMBER – SO NICE TO KNOW YOUR HEAT ISN’T WASTED’
‘TRUST A PRINCESS TO COPE WITH BATHS AND CENTRAL HEATING’
‘PLUS 2000 CUBIC FEET OF ROOM HEATING’
‘BREEDING COUNTS COMES FROM A GOOD SMOKELESS FAMILY’

RAYBURN PRINCESS MADE BY **ALLIED IRONFOUNDERS**

One of a large and highly efficient family of smokeless fuel appliances

ALLIED IRONFOUNDERS LTD, DOMESTIC APPLIANCE DIVISION, CADBURY ROAD, SUNBURY-ON-THAMES, MIDDLESEX

Stand No.

1, 2, 4 and 5 **ELECTRICAL DEVELOPMENT ASSOCIATION, Trafalgar Buildings, 1 Charing Cross, London, S.W.1. (Telephone: WHItehall 6757. Telex: 262279).**

Electricity Clears The Air

The surest way to clean air is the electric way. As a heat source it is 100% efficient and for other purposes it has an efficiency that is unchallenged.

Electric Space Heating

Electricity now offers a variety of heating systems designed to use electricity 'off-peak'. The newest of these employs large capacity storage heaters for use with ducted air systems; this type of heating is increasingly advocated for system-built houses and flats. Electric floor warming has long been an accepted method of heating new houses, flats and industrial and commercial buildings; this system is ideally suited to municipal developments where low installation and running costs matter most. Unit-plan heating, which is especially suitable for conversions or modernization schemes, has already been installed in a number of local authority housing projects.

Electric Water Heating

A well designed electric storage water heating system can now be installed as a packaged unit. This saves building and plumbing costs and ensures lowest running costs.

New Publication For Delegates

Ask for a copy of the new publication "Electricity for heating flats and houses". This gives information invaluable to committee members.

E1 **ELVACO HEATING LTD., Hanworth Trading Estate, Hampton Road West, Feltham, Middlesex.**

The Elvaco clean air central heating and ventilation system has been in wide use in a number of continental countries for more than a decade. It is based on controlled air circulation and consists of a central ventilation unit which introduces outdoor air, filters it and then distributes it through underfloor polythene ducts to diffusser units, where the air is heated by 'black heat' electrical elements.

There is now considerable operational experience in the U.K. and the system has been considered in view of its wide diversity due to short operating periods and close control, as an alternative to 'off-peak' storage. Individual thermostatic control is provided in every room and a reasonably well insulated 3-4 bedroom, semi-detached house can have a complete installation for about £300. Close control and direct heating means that the system is inherently flexible; the required room temperature can be obtained within twenty minutes of switching on and once the optimum room temperature is obtained the electrical load is spread evenly over the day.

SEE THE

Esso

CONTRIBUTION TO

CLEAN AIR &
WARMTH

STAND C13

Heating Sales Services
Esso Petroleum Co. Ltd., Victoria Street, London, S.W.1
Tel: VICtoria 6677

The system is particularly suitable for industrialized building systems and is also available for commercial and industrial use.

Every Elvaco installation is designed to suit individual requirements and the cost of a full central heating system to provide 70°F in living rooms and 65°F in bedrooms against an exterior temperature of 30°F in a 1,000 sq. ft. bungalow, is of the order of £290.

Running costs, with reasonable building insulation, are less than £45 per annum.

Existing houses can be fitted with the Elvaco system provided that they have wooden floors, although in this case prices would be increased by about 15%.

C13 **ESSO PETROLEUM CO. LTD., Victoria Street, Victoria, London, S.W.1.**

The Esso Exhibit provides information on heating to those concerned with Building and Clean Air.

The animated models and diagrams illustrate the Esso Centralised Fuel Distribution (C.F.D.) system, the unique method of transmitting not only a highly concentrated form of potential heat, but also one readily adaptable to automatic operation. C.F.D. can be the small bore system automatically feeding fuel at low cost to the small bore hot water system transmitting heat.

Such systems present many advantages to the Builder, Local Authority, the Consumer and Esso Petroleum Co. Ltd., and the increasing recognition of this new and novel approach is reflected by the numbers of fully operational C.F.D. systems in all parts of the U.K. which can be seen from the illuminated large scale map.

Information embracing other forms of modern oil-fired heating techniques are available, with especial reference to yet another concept of Group Heating to satisfy Clean Air, namely District Heating.

Esso have accepted the pipeline method of transmission as the progressive step to the future to provide all round economies to the needs of all interested parties. Advice on the most economic and architecturally desirable methods of integrating storage, boiler house design and heat metering is available.

Information is available on all aspects of Centralised Fuel Distribution, District Heating, Domestic Heating, Delivery Service, Cost and Fuels, etc. and literature is provided as well as technical representatives who are present to answer any questions that you may have.

D5 and D6 **THE GAS COUNCIL, 4-5 Grosvenor Place, London, S.W.1. (Telephone: BELgravia 4321).**

Visitors to The Gas Council Stand will be able to obtain up-to-date information on the vital part Gas is playing in the Clean Air Movement.

The Minister of Housing & Town Planning has agreed that a

Heatstore takes the cost out of central heating and gives a three year guarantee.

See our electric thermal storage heating on Stand B18.

grant in respect of the installation of Gas Convector Fires will apply in Smoke Control Areas.

The impact that Gas Convector Fires have made on the heating market, is shown by the amazing rise, year by year, in sales. The public have been quick to realize the advantages of this type of Heating—Efficiency, Cleanliness, and most economical running costs. A further important advantage of these heaters rests in the positive ventilation of the room—two to three complete air changes per hour—thus ensuring a fresh, healthy atmosphere.

A comprehensive range of the latest Gas Convector Fires will be on display for visitors to inspect.

Another prominent feature on the stand, will be that referring to Central Heating by Gas Fired Boiler and Gas Fired Warm Air Unit.

Animated diagrams will be shown indicating the installation of both of these Systems, and visitors will be able to see how simple the installations can be, in new or existing property.

Another section will be devoted to Incineration—where the latest types of Smokeless Incinerators will be available for inspection.

The latest types of Water Heaters will also be on display.

Visitors are cordially welcomed to The Gas Council Stand, where an expert team of salesmen will advise and help to solve your problems on Smoke Control.

B18 HEATSTORE LTD., Chapel Lane, Pinner, Middlesex.

Heatstore, as brand leaders in the controlled input domestic storage heating market, are showing examples of their S.D. range of electric thermal storage heaters. This range of products, of which over 70,000 were installed during the 1964-65 heating season, provide an effective electric central heating system which is cheaply, quickly and simply wired into the home and qualifies for a grant under the Clean Air Act.

Finishes, sizes and prices of the S.D. range of domestic storage heaters are as follows:

Model No.	S.D.1.	S.D.2.	S.D.3.
Loading	1.5 KW.	2.25 KW.	3 KW.
Dimensions			
Width	23 ins.	23 ins.	33 ins.
Height	22 ins.	25½ ins.	25½ ins.
Depth	10¼ ins.	10¼ ins.	10¼ ins.

Heaters are usually supplied in a choice of fawn cabinet with pale cream front panel or black cabinet with magnolia front panel at the following prices:

£21-0-0	£23-0-0	£27-10-0

Oriental walnut finished cabinets with cream front panel are available at the following prices:

£22-5-0	£24-10-0	£29-5-0

With the Heatstore system you do not have to install all your

‘I.O.’ = INDUSTRIAL ODOUR

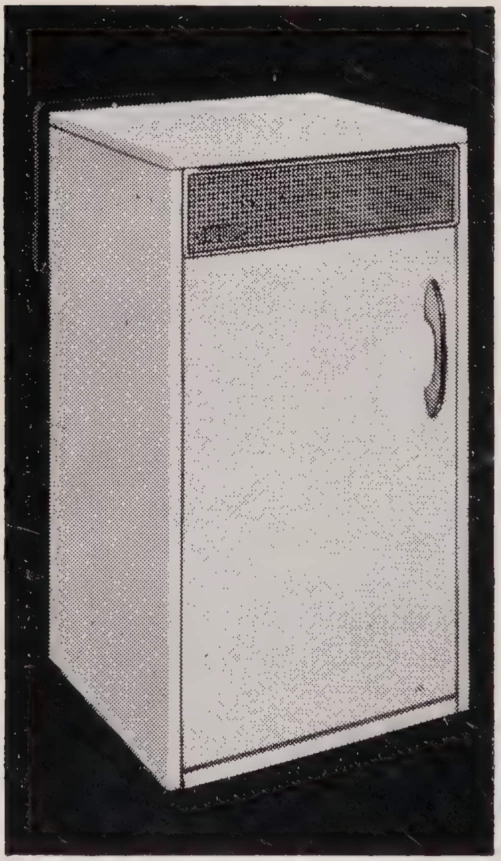
Is your factory unpopular?
Do other factories and estates complain?
Has your best friend told you?

One simple *KAVAG* installation with the active ingredient “CATALYTIC COMBUSTION” will solve the problem.

KAVAG

Somerset House,
Georges Square, Halifax

Tel.: Halifax 65109



CLEAN
EFFICIENT ECONOMICAL
BALANCED FLUE
GAS-FIRED BOILERS

The Glow-Worm Thermglow Mk 111B balanced flue boiler (illustrated) gives oceans of hot water and supplies 5/6 radiators plus a towel airer. It's clean, efficient, economical central heating with any of the Glow-Worm balanced flue range. There are four models in all — from 30,000 to 100,000 B.Th.U's. Prices start as low as £65.15.0. retail. Advantages include compact design for unobtrusive installation in the kitchen and a special design which means you need no chimney! (Models for standard flue connections are also available).

GO FOR
GLOW-WORM

GLOW-WORM LIMITED, 47 HATTON GARDEN, LONDON, E.C.1.

heaters at once. You can buy Heatstore room by room, and if you move you can take your heaters with you.

Also included is the latest addition to the Heatstore range, the C.F.3. controlled output heater. This new model which incorporates fans to control the heat output, represents the most compact heater of this type yet produced. It is styled to match the S.D. range in order that the two types may be included in an installation maintaining uniformity of appearance. The controlled output storage heater is ideally suited to heating rooms which are only occupied during a few hours each day when the room temperature can be raised to full comfort conditions by bringing the fans into operation.

The C.F.3. heater is supplied in fawn and cream finish, and will retail at approximately £45. Production will commence in November.

Also on display are examples of the Heatstore commercial range, designed for heating offices, shops and factories. These heaters which are designed for single or group control for use with suitable wall mounted thermostats, offer a very economical form of heating industrial premises and comply with clean air regulations.

All commercial models are finished in hammered bronze and are available at the following prices:—

Model	C.1.	C.2.	C.3.
Rating	1.5 KW.	2.25 KW.	3 KW.
Weight	255 lbs.	365 lbs.	490 lbs.
Length	23 ins.	32 ins.	41 ins.
Height	24½ ins.	24½ ins.	24½ ins.
Depth	12 ins.	12 ins.	12 ins.
Price	£16-10-0	£18-10-0	£23-10-0

B19 KAVAG, Somerset House, George Street, Halifax, Yorkshire.

KAVAG Katalytische Verbrennungsges. m.b.H. will be exhibiting the Catalyst used in Catalytic Combustion Equipment to eliminate completely obnoxious odours.

The Catalyst can be used in many different ways and flow diagrams will be on show demonstrating normal fume removal by Catalytic Combustion and also flow diagrams showing the latest developments for power and heat recovery from high energy off-gases.

Operating costs of the process will be shown demonstrating the possible savings that can be obtained with Catalytic Combustion.

Photographs of recent installations will also be displayed.

E4 "LOCAL GOVERNMENT CHRONICLE", 11-12 Bury Street, St. Mary Axe, London, E.C.3.

The *Local Government Chronicle* is essential reading for anyone wishing to keep up to date with the major and exciting changes that are taking place in local administration. It is the journal for those at the top—and those on their way to the top.

Every week the top experts in their fields write on financial, legal and planning matters. Weekly features also include answers to readers' queries, a report from Westminster and articles written specially for elected members.

Full and authoritative reports and previews of major conferences and exhibitions are published—a preview of this exhibition appeared in the issue of 23rd October. Reports on this conference will appear in future issues.

D4 **MINISTRY OF HOUSING AND LOCAL GOVERNMENT, Whitehall, London, S.W.1.**

The progress of the control of domestic smoke in England will be shown by diagram and graph on the Ministry of Housing stand.

Pictures of the cleaning of St. Paul's Cathedral, London, will be exhibited together with specimens of the material removed from the fabric of the Cathedral.

D7 **MINISTRY OF TECHNOLOGY, Millbank Tower, Millbank, London, W.1. (Telephone: VICtoria 2255).**
Warren Spring Laboratory, Stevenage, Hertfordshire. (Telephone: Stevenage 2080-8).

Many of today's worst air pollution conditions result from the way in which our towns and cities have developed piecemeal over the centuries. The policy of building complete new towns and redeveloping existing towns offers possibilities of largely eliminating air pollution in the development areas.

On the stand the principles of town planning to reduce air pollution to a minimum are illustrated by a model and by photographs, together with data showing what can be achieved.

E5 **THE MUNICIPAL JOURNAL GROUP OF COMPANIES, 3-4 Clement's Inn, London, W.C.2. (Telephone: CHAncery 1200. Telex: 262568. Telegrams: Minijournal London Telex).**

The Group's display features *Municipal Engineering*, local government's leading topical technical weekly noted for its fortnightly Data Sheets and frequent pull-out-and-file supplements.

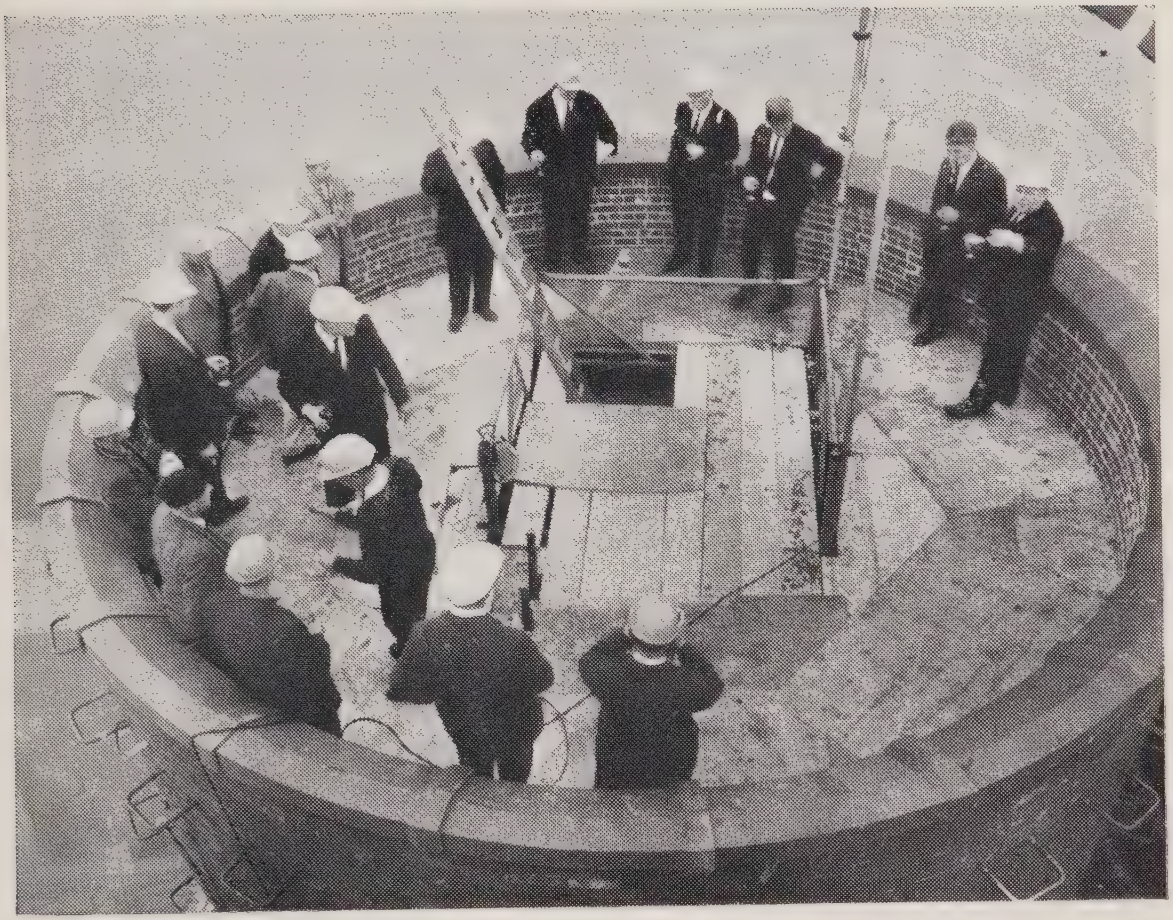
Other publications on display by The Municipal Journal Group are:

The Municipal Journal.
The Municipal Year Book & Municipal Buyer's Guide.
Digests of New Legislation (English & Scottish).
The Councillor's Handbook.
Local Government Today . . . and Tomorrow.
Crimp & Bruges.

A2 **NATIONAL CARBONISING COMPANY, LIMITED, Fullarton Lodge, Crow Hill Drive, Mansfield, Nottinghamshire. (Telephone: Mansfield 2357-9).**

The producers of Rexco Smokeless Coal display as the main feature of their stand a typical British home.

Power for clean air . . .



Recent "topping-out" ceremony for the single chimney at Eggborough 2,000,000 kilowatt power station, Yorkshire.

> *"The modern 2,000,000 kilowatt fuel-burning power station, virtually smokeless, fitted with high duty electrical dust arrestment plant and with waste gases discharged via a 650 ft. chimney is indeed a considerable achievement in the field of direct and indirect reduction of smoke and grit emission"*

. . . Dr. J. S. Carter, C.B.E., presenting the Des Voeux Memorial Lecture at the Annual Conference of the National Society for Clean Air, Harrogate, 1964.

The Generating Board will again have a stand at the Clean Air Exhibition, which takes place this year at the Winter Garden, Eastbourne, October 26 to October 29. The stand will feature the efforts of the CEGB to minimise atmospheric discharges from power stations and the research taking place into all aspects of the dispersal of flue gases, recording of dust fall and the measurement of sulphur dioxide in the vicinity of power stations.

CENTRAL ELECTRICITY GENERATING BOARD

LOOK– NO SMOKE!

Information and advice on smokeless solid fuels and appliances approved for use in Smoke Control Areas are readily available on Stand C3, or from the nearest Regional Sales office of the **NATIONAL COAL BOARD.**

Stand No.

The living room has a cheerful open fire, which using Rexco Smokeless Coal, has the added advantage of cleanliness to the usual cheerfulness and comfort, thus emphasizing the advantage over other forms of domestic heating.

The 'second' room has under fire a Redfyre room heater showing all the advantages of the open fire behind glass, giving a high rate of efficiency and using Rexco Smokeless Nuts which have a lower price than the Rexco open fire fuel.

Thus, preservation of the traditional scene in homes throughout the country can be maintained where Smoke Control Orders are made under the Clean Air Act by the householder using Rexco 'approved' Smokeless Coal.

This modern form of heating, in the traditional setting, becomes increasingly popular every year and the National Carbonising Company is continually increasing its production, emphasized this year by the opening in September, 1965 of a completely new Rexco works at Ollerton in Nottinghamshire, with an output of 200,000 tons per year.

Rexco is made from the finest quality washed lump coal and when burned produces bright flames and a strong radiant heat without smoke. By the use of lump coals the National Carbonising Company is able to market a product which suffers little from breakage in transit or when stocked.

Rexco is easily ignited using the normal methods and can be used successfully in any type of grate, old or new, thus avoiding the need to fit special grates and provide gas ignition.

The appliances on the stand are from the range of Redfyre Solid Fuel Appliances which are suitable for use on Local Authority Housing Contracts and in Smoke Control Areas generally.

Staff will be available on the stand to give information and deal with any enquiries with regard to Rexco Smokeless Fuel or Redfyre Solid Fuel Appliances.

C10 and C11 **NATIONAL COAL BOARD, Hobart House, Grosvenor Place, London, S.W.1.**

The National Coal Board stand has on show a selection of equipment designed to burn solid fuel smokelessly for commercial and industrial uses. A warm air unit is on display burning bituminous coal smokelessly. The most recent advances in equipment for the automatic control of boilers, smoke emission, and grit arresting are also on view.

Group Heating schemes based on solid fuel fired boilers centrally located are also featured in the display.

A5 and B11 **NATIONAL SOCIETY FOR CLEAN AIR, Field House, Breams Buildings, London, E.C.4. (Telephone: CHAncery 5038).**

Clean Air Poster Competition. On the stand will be displayed a number of entries which will include the five winning entries.

The winning designs are known only to the judges and will not be made public until Friday, 29 October, 1965. The public, including delegates, are invited to enter by placing the five winning entries in the same order as the judges. Valuable prizes which can be won in this "adult" part of the competition will also be shown. Details of the prizes for senior schoolchildren and students will also be shown.

Adjacent to stands E1, E2, E3, E4 and E5 the New Speed Frame display will be exhibited and also the Do-it-Yourself Exhibition Display kits which are available to local authorities and other bodies wishing to publicize Clean Air. The latter are for sale.

A selection of publications and literature will be on display at the conference office. Inquiries regarding advertising space in our publications, display panels and specimens of stonework and lungs available on loan should be made at the organizer's office.

E7 **PERGAMON PRESS LTD., Headington Hill Hall, Oxford.**

Pergamon Press is well established as one of the world's leading scientific publishing houses of important books, journals and serial publications covering virtually every field of science, technology, education and medicine.

The publications in the specialist field of air and water pollution cover such topics as: The measurement of pollutants; The modification of gaseous and particulate pollutants in the atmosphere including the effects of short wavelength illumination; Pollution in cities; Meteorological and aerodynamic aspects of air pollution; Radioactive pollutants; The effects of pollution on human health, and on plants; Methods of reducing the emission of pollutants.

You are invited to browse through the books and journals on display at the Pergamon Bookstand No. E7, these include:

Inhaled Particles and Vapours.
Atmospheric Pollution—its Origins and Prevention.
Industrial Electrostatic Precipitation.
Biological Waste Treatment.
Design and Use of Respirators.
Advances in Water Pollution Research (*In Three Volumes*).
Treatment and Disposal of Radioactive Wastes.
Public Cleansing: Refuse Disposal.
Waste Treatment.
International Journal of Air and Water Pollution.
Annals of Occupational Hygiene.
Building Science.

These books will be of interest to Public Health Inspectors, builders, architects, industrialists, engineers and everyone concerned with air and water pollution.

Stand No.

B7 **POTEZ INDUSTRIES OF IRELAND LTD., at Stevens & Uhart Ltd., London Road, High Wycombe, Bucks. (Telephone: High Wycombe 782).**

Central Heating Too Expensive?

Over the past few years intensive publicity has sold the idea of central heating to wide sections of the public who formerly would have been content with a traditional fire. But many people anxious to make the change to a modern heating system are forestalled by high installation costs. Potez systems of oil-fired, warm-air heating cater for this very large market. Potez offer two basic systems both of which provide, or can be adapted to provide, water heating:

(1) Space heating by a convector situated at a central point within the house.

(2) Full central heating by a furnace fitted with ducts which run to each room.

Space Heating By Oil-Fired Convectors:

With this method an oil-fired convector is situated in the main living room and, by the simple expedient of leaving the doors open whenever the room is not occupied, warm air circulates throughout the rest of the house. There is virtually no radiation from the unit itself, and an even temperature is maintained without any excessive heating at the point of installation. In a traditional semi-detached house a single heater can raise the living room temperature 30-40 degrees above the outside temperature.

Installation is simple and consists in attaching the unit to an existing flue and setting up an outside oil tank. The unit can be fed either by gravity or manually every 24 hours. A water-heating coil can be incorporated in the unit for a small extra charge. Once properly installed, Potez units require no further attention, apart from cleaning the filter and draining water from the integral tank once a year.

As Potez heaters provide instant warmth they are particularly suitable for pubs, churches, schools and halls where only intermittent heat is required.

Full Central Heating By Oil-Fired Furnace:

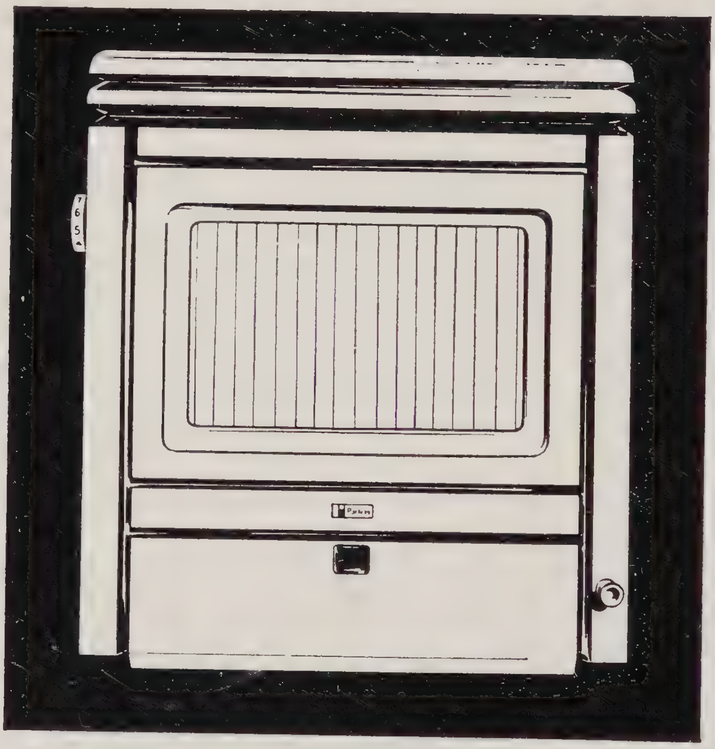
This system, built into a new house, provides full central heating and hot water for an addition to the building costs of between £120 and £150. Warm air from a central furnace circulates by natural convection through a series of ducts. Ducts and vents are fitted at ceiling level in each room on the ground floor, with a return air grille at low level to the hallway.

Potez Warm Air Generator 1542:

Built into a newly constructed house this system will cost about £400 complete. A fan-assisted generator delivers warm air within 15 minutes of lighting. The unit is silent in operation. The 1542 is suitable for all sizes of one or two-storey buildings.

SEE PARKRAY ON STAND C.12

Central heating from a real *smokeless* fire. Parkray 77K, the latest version of the highly successful 'open fire behind glass' heats the living room, provides ample domestic hot water *and* heats 3 radiators and a towel rail. This is without doubt the cheapest way to provide central heating and is equally suitable for new or existing houses. All Parkray appliances are suitable for use in Clean Air Zones as they all burn smokeless fuel.



Parkray **77 K**

central heating from a real fire

Stand No.

D2 THOMAS POTTERTON LIMITED, 102 Wandsworth High Street, London, S.W.18.

The latest contribution by Potterton to smokeless central heating appliances is the introduction of their completely new range of Diplomat Gas-Fired boilers. This range comprises five boilers, each available as a standard boiler or as a small bore unit. Each boiler is range-rated which means that its output can be adjusted on installation so that by matching the boiler output to the householder's requirements optimum efficiency is assured. The new range covers outputs from 30,000 to 80,000 Btu/h.

The boiler casings have been completely redesigned and are now of a standard height of 36 in., to match kitchen units.

The room sealed models of Diplomat gas-fired boilers, with outputs of 44,000 and 67,000 Btu/h, have also been improved by the incorporation of combination controls.

The new Potterton gas-fired WarmAir Units are represented by the smallest model, with outputs between 20,000 and 30,000 Btu/h. A larger model of 40,000 to 60,000 Btu/h output will soon be available.

Completing the range of domestic central heating boilers there are the popular BOA series of pressure jet boilers which are now available with higher outputs of 68,000, 108,000 and 148,000 Btu/h., and the range of Wallflame boilers with outputs of 40,000, 60,000, 80,000 and 100,000 Btu/h.

C12 RADIATION LIMITED, Radiation House, North Circular Road London, N.W.10. (Telephone: WILlesden 1234).

From the most comprehensive range of domestic heating and water heating equipment, produced by the Radiation Group of companies, appliances of particular interest for Smoke Control Area applications have been chosen for display at this Exhibition.

The latest models of the Parkray 'open fire behind glass' solid fuel room heaters offer many improvements over the models which pioneered the trend to glass-fronted room heaters.

The traditional desire for a visible fire is a logical outcome of the vagaries of the British climate, and an appliance which combines the heart-warming appeal of an open fire, the quick heating of a radiant fire and the economical efficiency of a closed convection heater is a popular solution to an indigenous problem.

The boiler models of the Parkray go even further; the 66 also provides domestic hot water, and the 77 will feed radiators for central heating.

Radiation Gas Fires Ltd., show examples from the widest range of gas fires available in the United Kingdom. A special feature of Radiation gas fires is their ability to be wall-mounted, making the conventional hearth and fireplace surround unnecessary, which means a saving in cost and valuable floor space.

The range of the famous Ascot gas water heaters includes instantaneous and storage models from sink heaters to large output

OIL?

FOR INDUSTRY CLEAN AIR compliance faces industry with many problems, commercially as well as socially. Oil-Firing can solve them, efficiently, economically and advantageously. Shell-Mex and B.P. Ltd not only supply this cleanly capable fuel but also offer a service. A service embracing every facet of oil's application and handling and storage. A service that is unsurpassed in experience and resources and which extends all the co-operation and advice that local authorities may require.

FOR THE HOME Here, too, oil has an answer to every problem. From full central heating to the cheapest home heating of all, paraffin heaters, there is a variety of ways to comply with the Clean Air Act and to suit everyone's need and budget.

On all matters concerning oil-firing and clean air, you are invited to make full and free use of Shell-Mex and B.P. service. This assistance can be obtained from a Shell-Mex and B.P. Industrial Fuels, or Domestic Fuels Representative —on request to the divisional office in your area or to head office in London.

SHELL-MEX AND B.P. LTD SHELL-MEX HOUSE
STRAND LONDON WC2 TEMple Bar 1234

SHELL

BP

Stand No.

storage and multipoint water heaters.

All Radiation appliances are Clean Air appliances and officially approved by the appropriate authorities—the Gas Council for gas-fired equipment, the Domestic Solid Fuel Appliances Approval Council for the Parkray appliances.

A3 and B15 **SHELL-MEX AND B.P. LTD., Shell-Mex House, Strand, London, W.C.2. (Telephone: Temple Bar 1234).**

The Domestic Markets Division of Shell-Mex and B.P. Ltd. will again be exhibiting along the theme "Oil and the Clean Air Act" and will be showing the various methods of home heating by oil. It will emphasise the services offered by the Company to the consumer and the local authorities when Clean Air zones are implemented. A selection of appliances designed for both existing houses and new houses will be displayed, ranging from a fixed paraffin heater to the larger type of unit.

C6 and C7 **SOLID SMOKELESS FUELS FEDERATION, 74 Grosvenor Street, London, W.1.**

The Solid Smokeless Fuels Federation is one of the organizations listed by the Ministry of Housing and Local Government from whom advice can be obtained on suitable appliances, their correct installation and proper operation, and the smokeless fuels to be used in Smoke Control Areas established by Local Authorities under the Clean Air Act.

The 1965 stand will display examples of the modern, efficient and highly attractive appliances which are capable of burning the full range of solid smokeless fuels.

Enquiries are welcomed from Local Authorities engaged in Smoke Control Programmes regarding the advice and assistance offered by the Federation, all of which is available free of charge.

B8 **THERMODARE (GREAT BRITAIN), Unidare House, Hayes End Road, Hayes, Middlesex. (Telephone: HAYes 8371).**

Thermodare, the originators of Off-Peak Night Storage Heating, are exhibiting a selected number of Heaters from their Domestic and Industrial ranges.

This method of Central Heating has the added advantage of combating condensation problems and ensuring that the building fabric is maintained in good condition.

In addition this system operates on low cost 'off-peak' electricity and only simple electrical circuits are required to complete the installation.

(Installation costs approximately half the cost of other systems).

This makes Thermodare Storage Heating an ideal proposition for local Authorities to use in existing buildings as this now qualifies for a grant, see M. of H. Circular 69/63.

The complete range of Thermodare Heaters, Domestic and Commercial (Industrial are all equipped with fusible safety link—

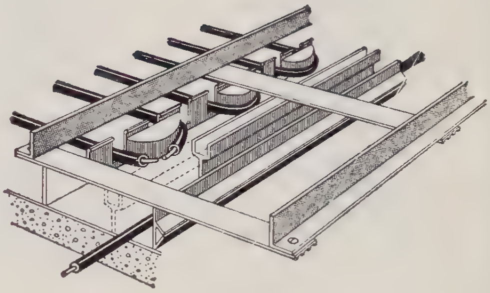
THERMODARE

originators of electric night storage heating

NIGHT STORAGE HEATING

pioneered and perfected by Thermodare

1 Avoidance of condensation.
2 Building fabric is maintained in good condition.
3 Decorations remain unimpaired.
4 Simplified costing: tenants can pay running costs individually or by apportionment.
5 Low capital and installation costs (installation costs alone are half that of conventional systems).
6 Thermodare units are standardised.
7 Temperature is maintained evenly and constantly.
8 Running costs are economical.
9 The first-rate functional design and styling harmonise with individual colour schemes and decor.



WARM FLOOR HEATING

Rewireable or embedded underfloor electric heating systems are adaptable to meet individual building requirements.

USE THE THERMODARE TECHNICAL SERVICE

Thermodare design engineers will be pleased to prepare quotations for any project which you may have in mind.

The sign of
Good Heating
THERMODARE

THERMODARE

Thermodare (Great Britain),
Unidare House, Hayes End Road,
Hayes, Middlesex.
Telephone: Hayes 8371

Patent No. 833,995) which affords complete protection and eliminates any fire risk.

The Domestic range of Models are available in a style and colour to suit the decor of any home, and are all equipped with the exclusive fire position thermostat (Patent No. 842,000) which enables them to be regulated appropriate to seasonal weather variations.

The Industrial/Commercial Models are controlled by a wall mounted thermostat which ensures that a steady temperature is maintained in all areas.

All heaters in the Renoir and Rembrandt range are suitably packaged for site assembly, but can, if required as an optional extra be delivered direct to site ready for immediate connections.

Prices are as follows:

RENOIR and REMBRANDT	1½ kW.	£19 10s. 0d.
RENOIR and REMBRANDT	2¼ kW.	£22 10s. 0d.
RENOIR and REMBRANDT	3 kW.	£27 10s. 0d.

Factory built units ready for immediate connection:

RUBENS	1½ kW.	£19 9s. 0d.
RUBENS	2½ kW.	£21 10s. 0d.
DFA.25 Fan Assisted	2½ kW.	£37 0s. 0d.

For further details of products, including Infra-Red and Warm Floor Heating please visit us on Stand No. B8.

D3 **THERMOTANK LTD., 150 Helen Street, Govan, Glasgow, S.W.1.**

"Dribore" Split Chimneys

Exhibited on the Thermotank Stand is a cross section of the new "Dribore" Split Chimney recently developed.

Thermotank have designed the "Dribore" split Chimney to overcome the serious corrosion and smut emission problems which can result on a multi-boiler installation when working on reduced loads.

The Split Chimney is segmented by splitter plates manufactured in the same "Dribore" construction methods adopted in the main flue i.e. two skins of mild steel with aluminium foil within the ⅝ in. air space to provide the insulation. As the splitter plates are insulated the most beneficial conditions exist to maintain the gases above the dew point and thereby eliminate smutting. Velocities are maintained and heat losses are at a minimum.

The "Dribore" split Chimney has been accepted by all interested parties i.e. Planning Authorities, Architects, Consulting Engineers and end users, as an extremely useful development. Cost can often be attractive against a number of chimneys, yet maintaining efficiency.

Thermotank have manufactured 2-way, 3-way and 4-way split "Dribores", the largest of which was recently installed at a site in Scotland at a large Brewery. This Chimney was 120 ft. high x 70 in. internal diameter, three-way split.

This development has overcome an extremely important design problem.

Stand No.

D9 **TOTAL OIL PRODUCTS (GB) LTD., Seymour Mews, Wigmore Street, London, E.C.1. (Telephone: HUN 4851).**

Total Oil Products (GB) Ltd., is the British marketing subsidiary of the giant French parent concern, Compagnie Francaise des Petroles (CFP), the seventh largest oil company in the world. Apart from the substantial chain of service stations built up in England over the past five years, Total has also created a network for the sale of all oil products as well as petrol—paraffin and fuel oil included.

All products are fully in accordance with B.S.I. standards and the company goes to great length to produce the purest fuel possible. A large proportion of the crude oil from which Total products are refined comes from the Sahara and is noted for its singularly low sulphur content. The sales network in Britain will be considerably strengthened in two years time when the Lindsy Oil Refinery, now being constructed on the Humber for Total, comes on stream.

Whatever Total products are purchased, they can be used with complete confidence that the most up-to-date resources of the industry are involved in their manufacture.

Total fuel oil is of high efficiency and free of smoke, making it ideal for industrial plants, central heating and domestic installations.

C14 and B10 **UNIVERSAL MACHINERY & SERVICES LTD., Viceroy Works, Millshaw, Ring Road, Beeston, Leeds, 11. (Telephone: Leeds 73761 (10 lines).**

The new Sealed Flame Disposal Units render obsolete previous conceptions of incineration.

First exhibited at the National Clean Air Conference at Harrogate last October, it was seen able to smokelessly incinerate every type of refuse including rubber, plastics, animal and vegetable matter, wet or dry.

They can be loaded by unskilled labour and left unattended to automatically incinerate without smoke or odour.

Operating and maintenance costs are low. There are no firebars or grates to clog, burn out or renew. It works on the prinicple of rear driven forced draught through air tubes located in the bottom of the curved hearth. Nothing can lie flat; the refuse is contained in a cocoon of air and burns right through under completely balanced conditions.

Consumption is negligible—approximately 140 cu. ft. on Town gas and as little as 1 lb. pressure with bottled gas, which supplies the patented afterburner. The stack mixing chamber converts the highly pre-heated smoke and air mixture into a gas ready for instant ignition and this is why the gas consumption remains low. Once the mixing chamber is hot, the unit will function for considerable periods with the gas completely off.

The performance of the incinerator can only be judged by public scrutiny of a working unit and that is the measure of the confidence in the performance of this unit.

The manufacturers of the Sealed Flame Units welcome visitors with any refuse problem and there is a written guarantee that the performance will fully meet with the provisions of the Clean Air Act and Local Authority regulations. Such is the unique construction and performance that the manufacturers are quite prepared to rent the equipment with option to purchase if desired.

Further information may be obtained from the sole manufacturers.

D1 **WALTON PLASTICS LIMITED, Windmill Road, Sunbury-on-Thames, Middlesex. (Telephone: SUNBURY 5131).**

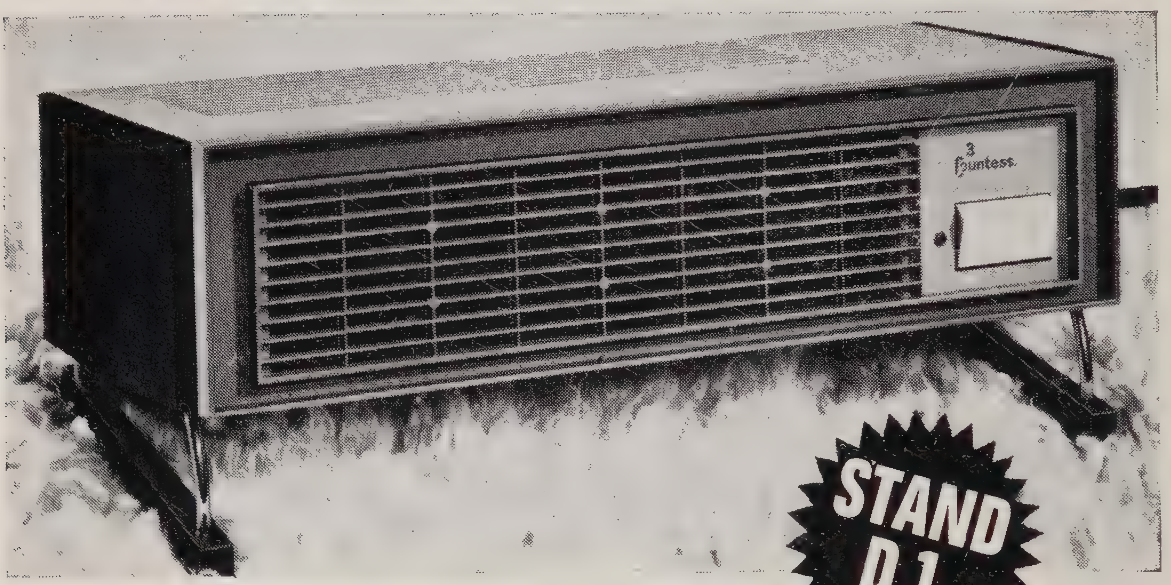
Selling Agents for Messrs. Golmet Products Ltd., of Blackwood, Monmouthshire, will be showing their range of 2 and 3 k.w. Tangential Fan Heaters, both the standard type of Countess model and their new fully B.E.A.B. approved Heater projected for 1966.

Various variations of these Heaters will be on show including fully thermostatically controlled models with built in thermostat, and other models capable of being used with the wall type Thermostat. Obviously, these will be of interest to many attending the Conference because of their low cost and easy installation giving automatic heating with the minimum delay.

HERE'S ALL-ROUND HEATING

for less than £12 per room

GOLMET 'COUNTESS' HEATER & THERMOSTATIC CONTROL



STAND D.1.

This beautifully designed heating equipment uses the latest tangential flow technique to distribute warm or cold air evenly round the room as required.

No need to switch on or off. No need to regulate as the temperature changes. *Once set the thermostatic control makes sure your room temperature stays exactly as you want it.*

It's the latest development in all-over heating. No fuss, no bother, no dirt, no storage space needed for fuel. *And no great initial outlay for boiler, pipes, and installation!*

GOLMET COUNTESS HEATER

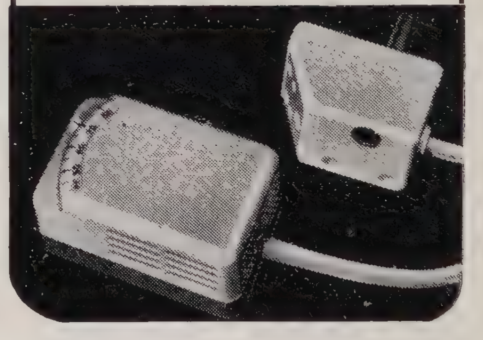
- ✳ Powerful motor with whisper silent operation.
- ✳ Adjustable positioning.
- ✳ Pilot light to show when 'on' and 'off'.
- ✳ Automatic cut-out for nursery safety.
- ✳ In two-tone grey and in 2 kw and 3 kw sizes.

Only **£7.19.6d.** (3 kw **£9.9.6d.**)

GOLMET THERMOSTAT CONTROL

Foolproof working and fingertip control. Made to fix at convenient height on the wall to give most accurate room temperature control.

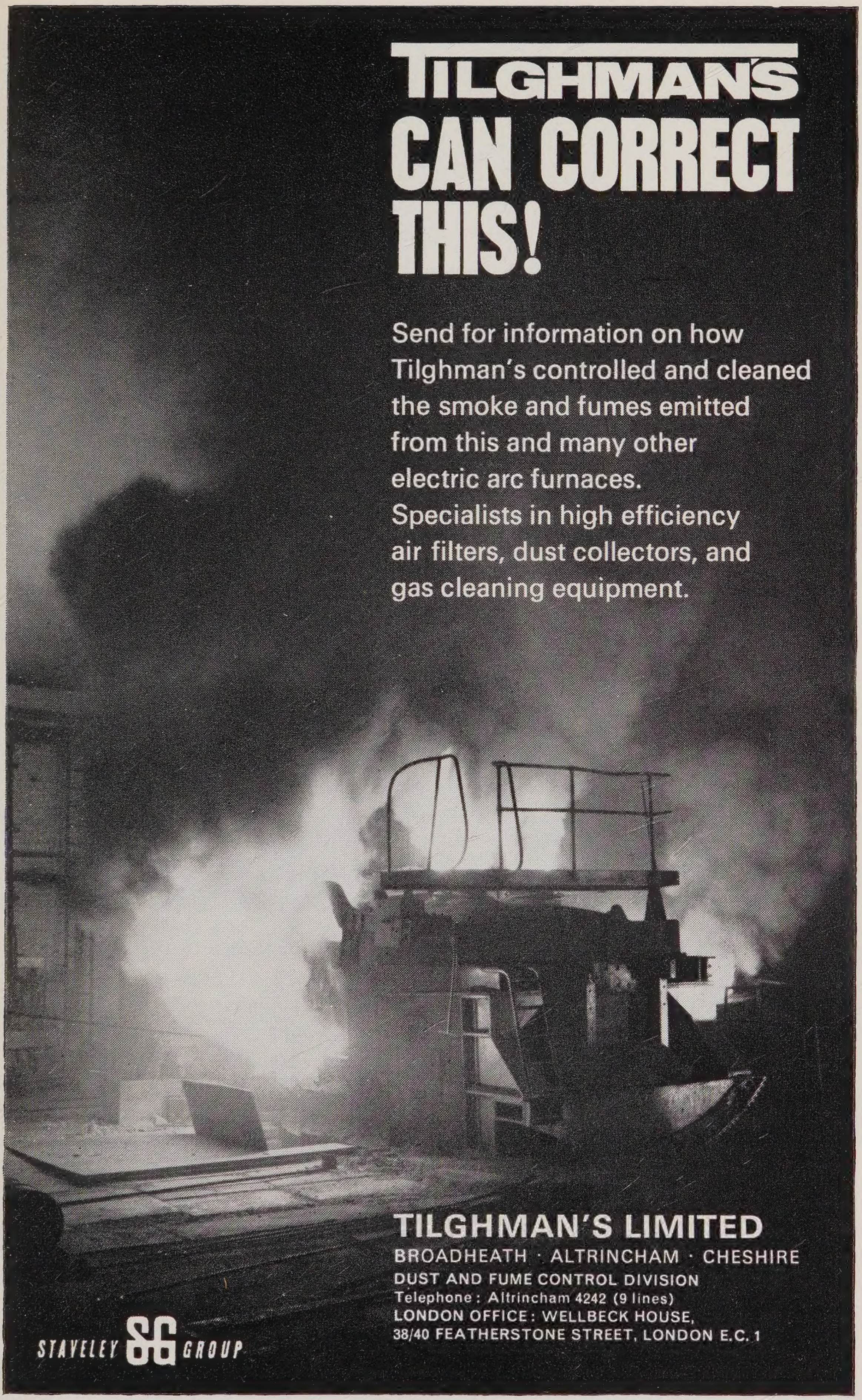
Only **£3.17.0d.**



From all good electrical shops: or write for further details and leaflet to:

Walton Plastics Limited, Windmill Rd, Sunbury-on-Thames, Middx.

A MEMBER OF THE AIRFIX GROUP OF COMPANIES



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THIS!

Send for information on how Tilghman's controlled and cleaned the smoke and fumes emitted from this and many other electric arc furnaces.
Specialists in high efficiency air filters, dust collectors, and gas cleaning equipment.

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BROADHEATH · ALTRINCHAM · CHESHIRE
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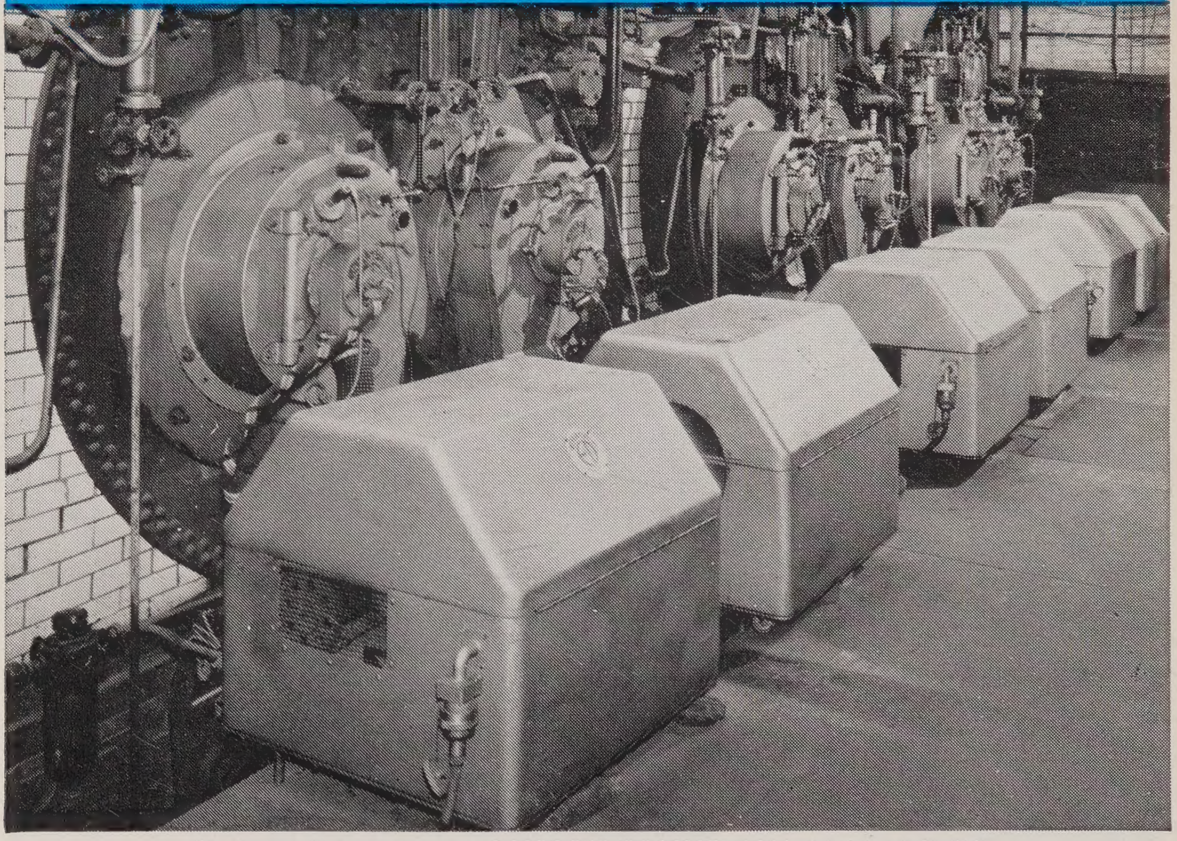
STAVELEY SG GROUP

Conversion to Oil-Firing is SIMPLE with Edwin Danks turbine driven Rotary Cup

'AIRSPIN' OIL BURNER



Photograph by courtesy of MORRIS COMMERCIAL CARS LIMITED another successful conversion by Edwin Danks of Oldbury.

Converting your boiler plant to oil-firing need not entail a major disorganisation or serious loss of production. The installation of Edwin Danks 'Airspin' Oil Burners is normally straightforward and simple.

Information on conversions — MULTIPLE and SINGLE UNIT—will be sent on request; and consultations freely arranged to discuss the advantages of the 'Airspin' Burner in your own plant.

ED OLDBURY

EDWIN DANKS & CO. (OLDBURY) LTD.

OLDBURY near BIRMINGHAM TEL: BRIERLEY HILL 77331

DESIGNERS AND MANUFACTURERS OF COMPLETE BOILER-HOUSE INSTALLATIONS & ANCILLARY EQUIPMENT

CLEAN AIR

The case for SOLID FUEL

Comfort

Most people still prefer the cheerful comfort of a solid fuel fire. A modern room heater or underfloor draught fire burning Sunbrite gives them just that, and meets all requirements of the Clean Air Act.

Health

With these appliances, unnecessary draughts are eliminated, but a natural circulation of air is encouraged, avoiding the discomfort and condensation problems associated with lack of ventilation.

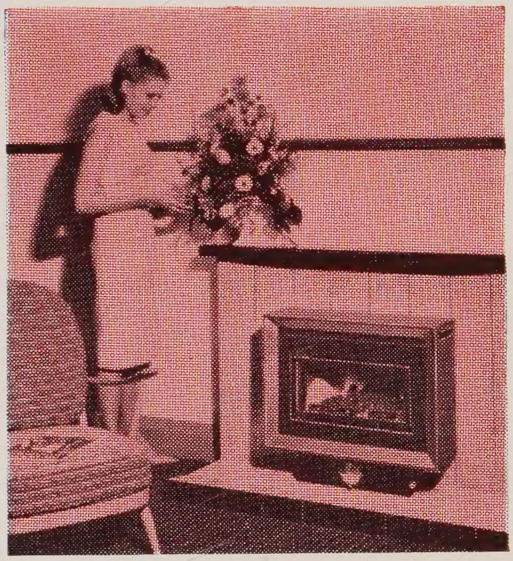
Efficiency

Room heaters are twice as efficient as the ordinary open fire, and boiler models are available to provide hot water and serve radiators.

Lower costs

Official Ministry figures prove that running costs for room heating plus hot water supply can be 25% lower than with any other fuel system.

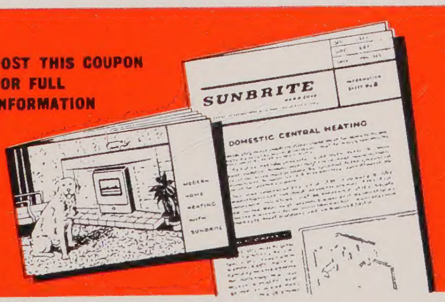
Room heaters and underfloor draught fires qualify for replacement grant in Smoke Control Areas. Solid smokeless fuels such as Sunbrite give excellent results on them.



Chatelaine Inset Room Heater

Baxi Underfloor Draught Fire

POST THIS COUPON FOR FULL INFORMATION



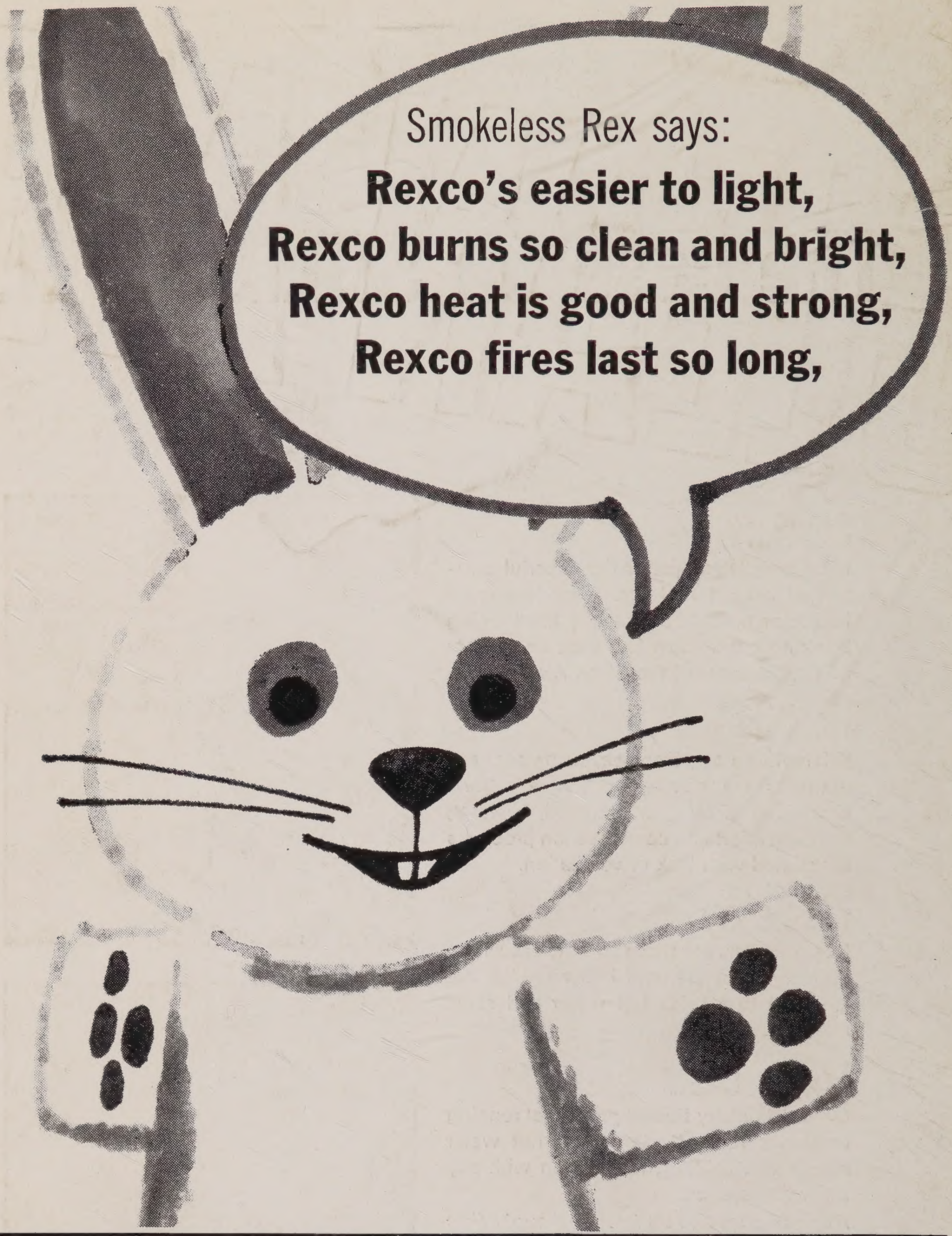
TO: THE BRITISH COKING INDUSTRY ASSOCIATION
74 Grosvenor Street, London, W.1.

Please send literature on room heaters and underfloor draught fires using Sunbrite.

NAME____________________

ADDRESS____________________

____________________C.A.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